UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

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First Named Inventor or Application Identifier	
OSAMU YUKI, ET AL.	
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Commissioner for Patents
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1. [ ] Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2. [X] Specification — *Total Pages* 32

3. [X] Drawing(s) *(35 USC 113)* — *Total Sheets* 22

4. [X] Patent Application Bibliographic Data Sheet — *Total Sheets* 1

5. [X] Oath or Declaration — *Total Pages* 1
   a. [X] Newly executed (original or copy)
   b. [ ] Unexecuted for information purposes
   c. [ ] Copy from a prior application (37 CFR 1.63(d))
   (for continuation/divisional with Box 18 completed)
   [Note Box 6 below]
   i. [ ] DELETION OF INVENTOR(S)
   Signed Statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

6. [ ] Incorporation By Reference *(useable if Box 5c is checked)*
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 5c, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

7. [ ] Microfiche Computer Program *(Appendix)*

8. [ ] Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. [X] Assignment Papers (cover sheet & document(s))

10. [ ] 37 CFR 3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney

11. [ ] English Translation Document *(if applicable)*

12. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations

13. [ ] Preliminary Amendment

14. [X] Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)

15. [ ] Small Entity Statement(s) [ ] Statement filed in prior application Status still proper and desired

16. [ ] Certified Copy of Priority Document(s)
(if foreign priority is claimed)

17. [ ] Other: _____

18. If a CONTINUING APPLICATION, *check appropriate box and supply the requisite information:*
[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No. ___/_____
Prior application information: *Examiner* _____ *Group/Art Unit:* _____

19. CORRESPONDENCE ADDRESS

[X] Customer Number or Bar Code Label — 05514 (Insert Customer No. or Attach bar code label here) — or [ ] Correspondence address below

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CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
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20. Small entity status

a. [ ] A small entity statement is enclosed

b. [ ] A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.

c. [ ] Is no longer claimed.

21. [X] A check in the amount of $ 768.00 to cover the filing fee is enclosed.

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23. The Commissioner is hereby authorized to credit overpayments or charge the following fees to Deposit Account No. 06-1205:

a. [X] Fees required under 37 CFR 1.16.

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SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED	
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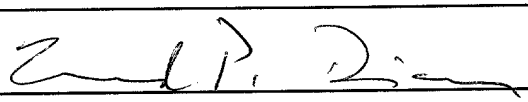
SIGNATURE	
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IMAGE PICKUP APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image pickup apparatus and method, and more particularly to an image pickup apparatus and method in which signals of pixels in an image pickup area are read out through addition thereof.

Related Background Art

A method is known by which a particular image pickup area is displayed with being magnified on a display device by using a smaller number of pixels than the display device. An image pickup apparatus using this method will be described.

Fig. 1 is a schematic diagram showing the structure of an image pickup apparatus. This image pickup apparatus is constituted of photoelectric conversion element 101, vertical transfer paths 102, storage units 103, a horizontal transfer path 104, a signal charge detector 105, and an output unit 106 provided on the opposite side of the horizontal transfer path 104. Arrows indicate a conventional transfer direction of signal charges.

Figs. 2A to 2K show typical pulse waveforms for driving the image pickup apparatus having the storage units. Fig. 2A shows a composite blanking signal,

Figs. 2B, 2C, 2D and 2E show four-phase clock signals to be applied to the vertical transfer paths 102, having vertical transfer pulse waveforms (hereinafter described as ϕVA1, ϕVA2, ϕVA3, ϕVA4) to be applied to gates VA1, VA2, VA3 and VA4. Figs. 2F, 2G, 2H and 2I show four-phase clock signals to be applied to the storage units 103, having vertical transfer pulse waveforms (hereinafter described as ϕVB1, ϕVB2, ϕVB3, ϕVB4) to be applied to gates VB1, VB2, VB3 and VB4. Fig. 2J shows a discrimination signal (hereinafter described as pre-blanking signal) for discriminating effective CCD output signals. Fig. 2K shows a transfer pulse (hereinafter described as horizontal transfer pulse) to be used for transferring signal charges in the horizontal transfer path 104 to the signal charge detector 105.

Next, a conventional method of driving an image pickup apparatus will be described with reference to Fig. 1 and Figs. 2A to 2K.

During a vertical blanking period A3, accumulated charges are transferred from the photoelectric conversion element 101 to the vertical transfer paths 102 in response to charge pulses C3 shown in Figs. 2B to 2E. Next, the charges are transferred from the vertical transfer paths 102 to the storage units 103 by a transfer amount corresponding to the number of stages of each storage unit in response to vertical high speed

transfer pulses F3. Next, during an image scanning period B3, the charges are transferred to the horizontal transfer path 104 during each horizontal period G3 by applying vertical transfer pulses I3 to the storage units 103. At the same time, during each horizontal period G3, i.e., at each timing of the vertical transfer pulses I3, signal charges on the horizontal transfer path 104 are output from the signal charge detector 105 by applying horizontal transfer pulses H3 to the horizontal transfer path 104. The horizontal transfer pulses have a frequency capable of transferring the signal charges of one horizontal scan.

From the start of the vertical blanking period A3 until application of the charge pulses C3, vertical high speed transfer pulses D3 are applied to the vertical transfer paths 102 to drain unnecessary charges in the vertical transfer paths 102 from the output unit 106 provided on the opposite side of the horizontal transfer path 104.

With this drive method, the vertical transfer paths 102 and storage units 103 can operate independently and an electronic shutter speed of 1/60 second to 1/1600 second can be attained.

Next, with reference to pulse waveforms shown in Figs. 3A to 3K, a method will be described by which an image pickup apparatus with storage units is driven to display a partial image area magnified to have twofold

vertical and horizontal lengths and a fourfold area ratio. Pulse waveforms shown in Figs. 3A to 3K are used for magnifying a central area of an image (this magnification operation is described hereinafter as an electronic zoom operation). Fig. 3A shows a composite blanking signal, Figs. 3B, 3C, 3D and 3E show four-phase clock signals to be applied to the vertical transfer paths 102, respectively represented by ϕVA1, ϕVA2, ϕVA3, ϕVA4. Figs. 3F, 3G, 3H and 3I show four-phase clock signals to be applied to the storage units, respectively represented by ϕVB1, ϕVB2, ϕVB3, ϕVB4. Fig. 3J shows a pe-blanking signal, and Fig. 3K shows horizontal transfer pulse waveforms.

During a vertical blanking period A4, accumulated charges are transferred from the photoelectric conversion element 101 to the vertical transfer paths 102 in response to charge pulses C4. Next, the charges are transferred from the vertical transfer paths 102 to the storage units 103 by a transfer amount corresponding to the number of stages of each storage unit in response to vertical high speed transfer pulses E4. In the storage units 103, the charges are transferred by a transfer amount more than the stages by one fourth the number of stages of each storage unit in response to vertical high speed transfer pulses F4 to drain the charges from the horizontal transfer path 104 and signal charge detector 105. Next, during an

image scanning period B4, charges left in the storage units 103 corresponding to three fourths the number of stages are transferred to the horizontal transfer path 104 by applying a vertical transfer pulse I4 to the storage units 103 at timing generally the center of each horizontal scan period and at every second horizontal periods. At the same time, during a period between two vertical transfer pulses, signal charges on the horizontal transfer path 104 are output from the signal charge detector 105 by applying horizontal transfer pulses H4 to the horizontal transfer path 104, the horizontal transfer pulses having a frequency capable of transferring the signal charges of one horizontal scan. With these operations, pixel signals of the photoelectric conversion element 101 in an area from about one fourth to three fourths of the photoelectric conversion element, viewed from the side of the storage units 103, i.e., pixel signals in the central area, are magnified and output during one image scanning period. At the end of the image scanning period B4, signal charges in the photoelectric conversion element in an area of one fourth, located at the opposite side of the storage units 103 are left in a partial area of the storage units 103. These remaining signal charges are transferred to the horizontal transfer path 104 and drained from the signal detector 105 in response to high speed transfer

pulses J4 applied at the start period of the next vertical blanking period A4.

Next, the detected signal charges are subjected to a blanking process by a signal processing circuit by using the blanking signal to delay one horizontal scanning period and interpolate the blank area. In this manner, the image magnified two times in horizontal and vertical directions can be displayed in the whole monitor area.

In the above-description, although the central area of an image is magnified, the area to be magnified may be set as desired.

With the above-described process, however, for example, if one fourth the image pickup area is to be displayed in the whole monitor area, the resolution is halved in both vertical and horizontal directions.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an image pickup apparatus capable of displaying an image in any area among a plurality of different divided areas in an image pickup plane with a less or no change in the resolution of the image.

In order to achieve the above object, according to one aspect of the present invention, there is provided an image pickup apparatus comprising: an image pickup area having a plurality of pixels; first read means for

reading signals of pixels contained in a first image pickup area in the image pickup area, through addition of n (n is a natural number) pixels; and second read means for reading signals of pixels contained in a second image pickup area smaller than the first image pickup area, through addition of m (m < n, m is a natural number) pixels or without addition.

According to another aspect of the present invention, there is provided a method of controlling an image pickup apparatus, comprising the steps of: reading signals of pixels contained in a first image pickup area in an image pickup area having a plurality of pixels, through addition of n (n is a natural number) pixels; and reading signals of pixels contained in a second image pickup area smaller than the first image pickup area, through addition of m (m < n, m is a natural number) pixels or without addition.

Other objects and features of the invention will become more apparent from the following detailed description of embodiments when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing the structure of CCD image pickup elements of a conventional image pickup apparatus.

Figs. 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2I, 2J and

2K are timing charts illustrating a conventional method of driving an image pickup apparatus with CCD image pickup elements.

Figs. 3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H, 3I, 3J and 3K are timing charts illustrating a conventional method of driving an image pickup apparatus in an electronic zoom operation.

Figs. 4A, 4B and 4C are schematic diagrams illustrating the outline of the invention.

Fig. 5 is a diagram showing the structure of an image pickup apparatus according to an embodiment of the invention.

Fig. 6 is a flow chart illustrating the operation of the image pickup apparatus according to the embodiment of the invention.

Fig. 7 is a flow chart illustrating the operation of the image pickup apparatus according to the embodiment of the invention.

Fig. 8 is a diagram showing an example of divided evaluation areas for AE/AF.

Fig. 9 is a diagram showing a memory map of an image pickup apparatus according to an embodiment of the invention.

Fig. 10 is a flow chart illustrating an operation of an image processing unit.

Fig. 11 is a circuit diagram showing the structure of a pixel of the image pickup apparatus.

Fig. 12 is a circuit diagram showing the structure of the image pickup apparatus.

Fig. 13 is a diagram showing the layout of pixels of the image pickup apparatus used by the embodiment.

Fig. 14 is a diagram showing the pixel layout of a display device used by the embodiment.

Fig. 15 is a diagram showing image data read in an addition mode.

Fig. 16 is a diagram showing image data read in a non-addition mode.

Fig. 17 is a diagram showing image data read in the addition mode.

Fig. 18 is a diagram showing the pixel layout used by the embodiment.

Fig. 19 is a diagram showing image data read in the addition mode.

Fig. 20 is a diagram showing the memory structure of a conventional image pickup apparatus.

Fig. 21 is a block diagram showing the structure of the image processing unit of a conventional image pickup apparatus.

Fig. 22 is a diagram showing the structure of an image processing unit of an image pickup apparatus according to an embodiment of the invention.

Fig. 23 is a block diagram showing an example of the circuit structure in the addition and non-addition modes.

Fig. 24 is a block diagram showing another example of the circuit structure in the addition and non-addition modes.

Fig. 25 is a diagram showing a storage state of AE/AF data.

Figs. 26A and 26B are diagrams illustrating limitation of a read area of an image pickup element.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The outline of the invention will be described with reference to Figs. 4A to 4C. As shown in Fig. 4A, the number of pixels in an image pickup area 200 of image pickup element is a0 × b0, the number of pixels in an image pickup area 201 smaller than the image pickup area 200 is a1 × b1, and the number of pixels in an image pickup area 202 smaller than the image pickup area 201 is a2 × b2.

According to the invention, pixel data is read in a first mode, through addition of n (n is a natural number) pixels in the image pickup area 201 (first image pickup area), and pixel data is read in a second mode, through addition of m (m < n; m is a natural number) pixels in an image pickup area (second image pickup area) or without addition. Although addition-read is executed in the first mode for the image pickup area 201 in the image pickup area 200, if addition-read is executed in the first mode for the whole image

pickup area 200, it can be considered that the image pickup area 201 is replaced by the image pickup area 200 (the first image pickup area of the present invention corresponds to the image pickup area 200).

As shown in Fig. 4B, if the number of pixels of a3 × b3 (< a1 × b1) subjected to the addition-read in the first mode is set equal to the number of pixels of a2 × b2 subjected to the non-addition read in the second mode (if a3 × b3 = a2 × b2), the number of pixels of signals read in the first mode becomes equal to the number of pixels read in the second mode. Therefore, it is possible to incorporate the same structures of a storage area and an image processing unit for executing high frequency luminance processing, chrominance processing and the like. If the number of pixels of a3 × b3 (< a1 × b1) subjected to the addition-read in the first mode shown in Fig. 4B is set equal to the number of pixels of a4 × b4 (< a2 × b2) subjected to the addition-read in the second mode shown in Fig. 4C (if a3 × b3 = a4 × b4), then it is also possible to incorporate the same structures of the storage area and the image processing unit.

Embodiments of the invention will be described in detail with reference to the accompanying drawings.

Fig. 5 is a diagram showing the structure of an image pickup system according to a first embodiment of the invention.

Light from an object passes through an iris 1 and focussed upon an image pickup element (image pickup area) 4 which photoelectrically converts the incidence light into electric signals. Reference numeral 3 represents a filter group constituted of a combination of an optical low-pass filter for cutting high frequency components to eliminate moire or the like, a color compensation filter, an infrared ray cutting filter and the like.

An address designation unit 8 supplies an address signal to an X address selection unit 6 and a Y address selection unit 5 to designate an address in the two-dimensional pixel area and read an image signal photoelectrically converted by the image pickup element 4. The read image signal is supplied to a timing adjustment unit 7 which executes adjustment of a timing of outputs (one to a plurality of outputs) from the image pickup element 4. The voltage of an image signal output from the timing adjustment unit 7 is controlled by an auto gain control (AGC) 10 and then the image signal is converted into a digital signal by an A/D converter 11.

A camera DSP 12 executes image processing on a still image signal or a moving image signal. An MPU 14 sets parameters to be used for this image processing, and executes AE and AF processing. The AF control is performed by moving back and forth a focus lens (not

shown) by a focus motor 51.

A DRAM 13 is used as a temporary storage area for the image processing. An image recording medium 18 is used as a non-volatile storage area. The image recording medium 18 may be a Smart medium, a magnetic tape, an optical disk or the like.

A video encoder 15, CRT 16 and the like are provided for displaying processed images. A viewfinder 17 such as an LCD is used for monitoring the object before its image data is stored in the image recording medium 18. As these output devices, not only CRT 16 and viewfinder 17 but also a printer and the like may be used.

A display area designation unit 19 is a pointer device for designating a read area of, e.g., horizontal 800 pixels × vertical 500 pixels shown in Fig. 16 in the image pickup element having horizontal 1600 pixels × vertical 1000 pixels shown in Fig. 13. In this embodiment, a center point of the read area is designated. Namely, the coordinate value (800, 500) of the center point in the pixel area of horizontal 1600 pixels × vertical 1000 pixels shown in Fig. 13 is designated.

Fig. 6 is a flow chart illustrating the overall operation of the image pickup system, Fig. 7 is a flow chart to be followed by the flow chart shown in Fig. 7, and Fig. 10 is a flow chart illustrating the operation

of image processing.

After the power of the image pickup system is turned on, exposure and focus evaluations are executed for divided areas R2 to R5 (including a central area R1) of the image pickup element such as shown in Fig. 8, and evaluation values are stored in the memory (DRAM) 13 (S1 and S2 in Fig. 6). This evaluation is executed periodically.

If image pickup is on, a mode is discriminated (S3 and S4 in Fig. 6). If an addition mode, an addition scan mode for a plurality of pixels of the image pickup element is set to the address designation unit 8 (S5 in Fig. 6). For example, in this mode, addition scan such as shown in Fig. 15 is set.

Next, MPU 14 reads addition mode AE data from the memory, e.g., addition mode AE data for the central area R1 shown in Fig. 8, and sets the iris 1 and an amplification factor of AGC 10 (S6 in Fig. 6). Similarly, addition mode AF data for the central area R1 shown in Fig. 8 is read from the memory to perform an AF control by making the focus motor 51 move the focus lens (not shown) back and forth (S7 in Fig. 6).

If it is judged at S4 that the mode is a non-addition mode, an image pickup area is designated by using the display area designation unit 19 or pointer device (S8 in Fig. 6). In accordance with this zoom position, start addresses are set to the X and Y

address selection units 6 and 5. In this case, the address designation unit 8 designates the pixel read address of sequential scanning, which is increased one pixel after another for both X and Y addresses (S9 in Fig. 6).

MPU 14 reads non-addition mode AE data from the memory, e.g., non-addition AE data for the upper left R2 area shown in Fig. 8, and sets the iris 1 and an amplification factor of AGC 10 (S10 in Fig. 6). Similarly, non-addition mode AF data for the upper left area R2 shown in Fig. 8 is read from the memory, and the focus motor 51 drives the focus lens (not shown) back and forth to execute the AF control (S11 in Fig. 6).

The image pickup data of each mode is converted into digital image pickup data by the A/D converter 11 and stored in DRAM 13. In both the addition and non-addition modes, the same memory area 29 (shown in Fig. 9) is used.

The stored image pickup data is processed in the manner as illustrated in the flow chart of Fig. 10. The processed image pickup data is supplied as a luminance signal and color different signals which are subjected to a video-encode process and the like and used for CRT display, image recording, or viewfinder display as illustrated in the flow chart of Fig. 7. A series of above-described operations is repeated

starting from the image pickup on/off judgement step.

The addition mode and non-addition mode will be explained in detail.

First, the operation of the image pickup element used by this embodiment will be described. In Fig. 11, reference numeral 158 represents a MOS transistor serving as a potential barrier controlling transfer gate which transfers electric charges accumulated in a photodiode 150 (hereinafter described as PD) to the floating diffusion (hereinafter described as FD) gate of an amplification MOS transistor 160. Reference numeral 157 represents a reset MOS transistor for resetting electric charges in PD 150. Reference numeral 159 represents a line selection MOS transistor. The gates of these MOS transistors 158, 157 and 159 are connected to a transfer signal line 153 for transferring charges in PD 150, a reset signal line 156 for resetting FD 150, and a selection signal line 152, respectively.

Electric charges accumulated in PD 150 are transferred to FD which is reset upon turn-on of the reset transistor 157 by the reset signal line 157, via the MOS transistor 158 selected by the transfer signal line 153, amplified by the source follower MOS transistor 160 with the MOS transistor 159 selected by the selection signal line 152, and then output from a vertical output line 154.

Fig. 12 is a diagram showing an image pickup area constituted of a pixel area and a read circuit, the pixel area having a plurality of pixels shown in Fig. 11 disposed along horizontal and vertical directions. In Fig. 12 only 2 × 2 pixels are shown for simplicity.

For the non-addition control, when a MOS transistor 161-1 shown in Fig. 12 is made conductive by a signal line 169, electric charges in PD 150-1 are stored in a capacitor 162-1. Similarly, electric charges in PD 150-2 are read to a capacitor 164-1 during the read control of PD 150-1 by signal lines 156-1, 153-1, 152-1 and 169. Next, signal lines 167-2 and 168-2 are alternately turned on to read image pickup signals of PD 150-1 and PD 150-2 via an amplifier 172. Electric charges of the next row in the vertical direction can be read by using signal lines 156-2, 153-2 and 152-2 in the manner similar to the above-described operation.

For the addition control, by using signal lines 156-1, 153-1, 152-1 and 169, electric charges in PD 150-1 and PD 150-2 are stored in the capacitors 162-1 and 164-1. Next, by using signal lines 156-2, 153-2, 152-2 and 170, electric charges in PD 150-3 and PD 150-4 are stored in the capacitors 162-2 and 164-2. Thereafter, by turning the signal lines 167-1, 167-2, 168-1 and 168-2 on at the same time, electric charges of PD 150-1, PD 150-2, PD 150-3 and PD 150-4 are added

together on a horizontal output line (common output unit) and the added image pickup signal is read out via the amplifier 172. If electric charges of PD 150-1 and PD 150-4 are stored in the capacitors 162-1 and 164-2 and thereafter the signal lines 167-2 and 168-2 are turned on at the same time, an image pickup signal of added electric charges of PD 150-1 and PD 150-4 can be read via the amplifier 172. Electric charges of PD 150-1, PD 150-2, PD 150-3 and PD 150-4 are output from amplifier 172 without addition by sequentially turning the signal lines 167-1, 167-2, 168-1 and 168-2 on.

With the above-described control, the non-addition and addition operations can be executed.

As described above, a desired position in the vertical direction can be selected by a selection control means constituted of the signal lines 156, 153 and 152, and a desired position in the horizontal direction can be selected by a control means constituted of the signal lines 167 and 168.

Fig. 13 shows a pixel unit 20 constituted of horizontal 1600 pixels × vertical 1000 pixels used by the embodiment described earlier.

In the addition mode for the pixel unit 20, an image is displayed in the whole area of a display device 30 having horizontal 800 pixels × vertical 500 pixels shown in Fig. 14, by performing pixel addition indicated at 40 in Fig. 15. The optical low-pass

filter of the optical filter group 3 shown in Fig. 5 is designed so that aliasing noises are not superposed on the object image in the area of 1600 pixels × 1000 pixels. Therefore, if image signals are read by simply picking one pixel from four pixels, moire is formed in the image. In order to avoid this, in this addition mode, as indicated at 40 in Fig. 15, a plurality of pixels are added in vertical and horizontal directions for R and B, and a plurality of pixels are added in diagonal direction for G. Therefore, the spatial frequency of an object image in the addition direction can be lowered and false color to be caused by aliasing noises can be mitigated.

In the non-addition mode, as indicated at 50 in Fig. 16, an image in a quarter area of the pixel unit 20 is displayed and this mode corresponds to a partial zoom. The zooming position is designated by the display area designation unit 19. In this example, the central area (a pixel area from 250-th row to 750-th row and from 400-th column to 1200-th column of the pixel unit shown in Fig. 13) is zoomed. In this case, as indicated at 50 in Fig. 16, non-addition image pickup signals of horizontal 800 pixels × vertical 500 pixels are read. Therefore, one pixel of an image pickup signal corresponds to one pixel of the display device shown in Fig. 14. As compared to a conventional method by which only some pixels are used in a zoom

display of one pixel of the image pickup signal, the resolution becomes sufficient.

The number of pixels to be read from the pixel unit is determined both in the addition mode and non-addition mode so as to match the display device 30 having horizontal 800 pixels and vertical 500 pixels. Therefore, the non-addition mode display magnifying a partial area of the addition mode display can be performed without degrading the resolution.

In the embodiment described above, the addition mode illustrated in Fig. 15 is performed for horizontal 800 pixels and vertical 500 pixels starting from the pixel G_{11}, relative to all the pixels shown in Fig. 14. An addition mode illustrated in Fig. 17 may be performed for horizontal 1600 pixels and vertical 1000 pixels starting from the pixel G_{11}. The area from G_{11} to (800, 500) and the area from G_{11} to (1600, 1000) can be displayed at the same display resolution and with different angles of view.

If a complementary color filter is used with the pixel unit 20, pixels from G_{11} to (800, 500) are read in the non-addition mode as illustrated in Fig. 18, and after the color separation and image processing, the image pickup signal is displayed on the display unit 30 having horizontal 800 pixels × vertical 1000 pixels.

In the addition mode, the addition illustrated in Fig. 19 may be performed to display an image having the

maximum angle of view on the display device 30. In this case, color separation and image processing are similar to the non-addition mode described above.

In an image pickup apparatus having a plurality of image pickup modes, for example, as shown in Fig. 20, it is conceivable that two series of an addition mode memory 28 and a non-addition mode memory 27 are used. Stored image data is independently processed by an addition processing unit 21 and a non-addition processing unit 22 shown in Fig. 21. With this processing scheme, however, the capacity of the memories is a total sum of the capacities of the addition mode memory and non-addition mode memory so that a large capacity becomes necessary. Two series of processing unit are required and a large scale and high speed processing unit becomes necessary.

In contrast, in the second embodiment, in the addition mode, addition of pixel signals is executed in the image pickup element (image pickup area) 4, and in the non-addition mode, the X and Y address selection units 6 and 5 designate a read position, and a zoom operation is performed by using the same number of pixels as the addition mode. In this manner, the common memory 13 shown in Fig. 9 can be used for both the addition mode and non-addition mode. The series of processing by the camera DSP 12, such as a separation processing 31 of luminance and chrominance, white

balance (hereinafter abbreviated as WB) processing 41, gamma (hereinafter abbreviated as γ) corrections 34 and 42, monochromatic clip processing 35 and 43, low-pas filter processing 37, 44 and 45 shown in Fig. 22, can be attained with a common processing unit for the both modes.

Addition processing in the addition mode may be realized by providing a line memory 50 and an adder 51 between the A/D converter 11 and DRAM 13, as shown in Fig. 23. In this manner, the pixel addition can be performed similar to pixel addition in the pixel unit.

In the first and second embodiments, if all pixel signals are not required to be read from the pixel unit, only necessary pixel signals are read and output from the pixel unit. All pixel signals in the whole pixel area may be read from the pixel unit and stored once in DRAM 13. Thereafter, as shown in Fig. 24 pixel signals in the whole pixel area may be read from DRAM 13 and added by an adder 51' to thereafter input to the camera DSP 12, or only necessary pixel signals may be read from DRAM 13 and input to DSP 12 without addition or after addition input to DSP 12.

Next, the third embodiment of the invention will be described.

In a general exposure control mechanism, the optical iris 1 and a magnification factor of AGC 10 are controlled. With this control method, as disclosed in

JP-A-62-110369, an image frame is divided into a central area and peripheral areas, and an image signal level in each area is detected as an evaluation value which is weighted to control the optical iris and the magnification factor for an image signal.

However, if the image apparatus has a plurality of modes like the embodiment apparatus, only one kind of exposure amount detection is not sufficient for automatic exposure (AE) control.

Image signals of areas R1 to R5 shown in Fig. 8 pass through a low-pass filter (LPF) 23 shown in Fig. 25, integrated by an integrator 24, and stored in AE data storage areas AE1 to AE5 in DRAM 13. For example, for 400 thousand-pixel zooming in the non-addition mode, an integrated output of the area R2 shown in Fig. 8 of the sensor or image pickup element 4 is stored as AE data 1. In the addition mode, since image signals in the whole area of the sensor 4 are used, an integrated output of the area R1 or central area shown in Fig. 8 is stored as AE data 2.

In this manner, an exposure evaluation value for each mode is stored in the memory. When the mode is switched, the AE control is performed in accordance with the stored photometry evaluation value. In this manner, exposure suitable for a light amount in a desired zooming area can be set quickly.

Photometry evaluation values of the areas R1 to R5

may be stored in advance in DRAM 13. In this case, in accordance with the selected mode and zooming area, the AE control is performed, and then a desired area in the image pickup element 4 can be zoomed quickly.

In a general focus control mechanism, the focus motor is driven to obtain an in-focus state, in accordance with a comparison of the focus evaluation values between the current field and previous field.

Similar to the AE control, if the image apparatus has a plurality of modes like the embodiment apparatus, only one kind of focus evaluation value is not sufficient for quick automatic focus (AF) control.

Image signals of areas R1 to R5 shown in Fig. 8 pass through a high-pass filter (HPF) 25 shown in Fig. 25, are integrated by an integrator 26, and are stored in AF data storage areas AF1 to AF5 in DRAM 13. For example, for 400 thousand-pixel zooming in the non-addition mode, an integrated output of the area R2 shown in Fig. 8 of the image pickup element 4 is stored as AF data 2. In the addition mode, since image signals in the whole area of the sensor 4 are used, an integrated output of the area R1 or central area shown in Fig. 8 is stored as AF data 1.

In this manner, a focus evaluation value for each mode is stored in the memory. When the mode is switched, the AF control for a desired zooming area can be reliably and quickly performed in accordance with

the stored previous field focus evaluation value and current field focus evaluation value.

Focus evaluation values of the areas R1 to R5 may be stored in advance in DRAM 13. In this case, in accordance with the selected mode and zooming area, the AF control is performed, and then the AF control for the desired zooming position in the sensor 4 can be performed quickly.

Next, the fourth embodiment of the invention will be described. In this embodiment, the display area designation unit 19 shown in Fig. 5 is used for designating a center of a block to be read in the non-addition mode. The display area designation unit 19 may be a pointer for designating the start and end points.

It is assumed herein that horizontal 800 pixels × vertical 500 pixels are fixed as a read area size as shown in Fig. 16. If a coordinate (1600, 800) shown in Fig. 26B is designated, there is an area from which pixel signals cannot be read. In this case, it is assumed that a point d shown in Fig. 26A, i.e., a coordinate (1200, 600), was pointed and pixel signals are read from a hatched area and displayed. Other points a (400, 200), b (1200, 200) and c (400, 600) are also provided in correspondence with the three corners to thereby limit the display area.

If a coordinate is designated which requests the

read area other than the read areas corresponding to the points a to d, then it is assumed that one of the points a to d nearest to the designated coordinate was pointed to select the corresponding read area, and thereby limiting the display area.

As described so far, according to the embodiments of the image pickup apparatus, the first addition mode and the non-addition mode (or second addition mode using the number of pixels smaller than the first addition mode) are controlled to perform a zoom display without degradation of the resolution.

The same number of read pixel signals are used for both the first addition mode and the non-addition mode (second addition mode using the number of pixels smaller than the first addition mode). Therefore, the same structure of the processing circuit can be used for both the modes, and a memory and processing circuit of one series can be used.

When the image pickup area or the mode is switched, the AE/AF control can be performed smoothly by using prestored values.

Many widely different embodiments of the present invention may be constructed without departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiments described in the specification, except as defined in the appended claims.

WHAT IS CLAIMED IS:

1. An image pickup apparatus comprising:

an image pickup area having a plurality of pixels;

first read means for reading signals of pixels contained in a first image pickup area in said image pickup area, through addition of n (n is a natural number) pixels; and

second read means for reading signals of pixels contained in a second image pickup area smaller than the first image pickup area, through addition of m (m < n, m is a natural number) pixels or without addition.

2. An image pickup apparatus according to claim 1, wherein said image pickup area includes a common output unit to which signals of a plurality of pixels are read and output sequentially, said first read means reads signals through addition of n pixels to the common output unit, and said second read means reads signals through addition of m pixels or without addition to the common output unit.

3. An image pickup apparatus according to claim 2, wherein said first read means performs addition of n pixels in the common output unit.

4. An image pickup apparatus according to claim 1, further comprising:

analog/digital conversion means for converting a signal read from said image pickup area into a digital signal,

wherein said image pickup area includes a common output unit to which signals of a plurality of pixels are read out sequentially and whose output is supplied sequentially to said analog/digital conversion means,

wherein said first read means reads out digital signals converted by said analog/digital conversion means through addition of n pixels, and

wherein said second read means reads out digital signals converted by said analog/digital conversion means through addition of m pixels or without addition.

5. An image pickup apparatus according to claim 1, further comprising image data processing means for processing signals read by said first read means and signals read by said second read means by using a same processing unit.

6. An image pickup apparatus according to claim 1, wherein the number of signals read by said fist read means is approximately equal to the number of signals read by said second read means.

7. An image pickup apparatus according to claim 1, further comprising control means for storing an

exposure evaluation value and a focus evaluation value for said image pickup area and using the exposure evaluation value and the focus evaluation value for an exposure control and a focus control in accordance with designation of either said first read mans or said second read means and/or in accordance with designation of a read area of the plurality of image pickup areas.

8. An image pickup apparatus according to claim 1, further comprising:

a lens for focussing light upon said image pickup area; and

image data processing means for forming a luminance signal and color signals by processing signals read from said image pickup area.

9. An image pickup apparatus comprising:

an image pickup area including pixels arranged in horizontal and vertical directions, vertical output lines to which signals of pixels are read out and a horizontal output line to which signals from the vertical output lines are read out; and

a driver circuit for controlling transistors in said image pickup area so that signals of pixels contained in a first image pickup area in said image pickup area are read out through addition of n (n is a natural number) pixels to the horizontal output line

and signals of pixels contained in a second image pickup area smaller than the first image pickup area are read out through addition of m (m < n, m is a natural number) pixels or without addition to the horizontal output line.

10. An image pickup apparatus comprising:

an image pickup area including a plurality of pixels;

an analog/digital converter circuit for converting a signal read out from said image pickup area into a digital signal; and

a processing circuit for processing digital signals which are output from said analog/digital converter circuit and correspond to pixels contained in a first image pickup area in said image pickup area, through addition of n (n is a natural number) pixels and processing digital signals of pixels contained in a second image pickup area smaller than the first image pickup area through addition of m (m < n, m is a natural number) pixels or without addition.

11. A method of controlling an image pickup apparatus, comprising the steps of:

reading signals of pixels contained in a first image pickup area in an image pickup area having a plurality of pixels, through addition of n (n is a

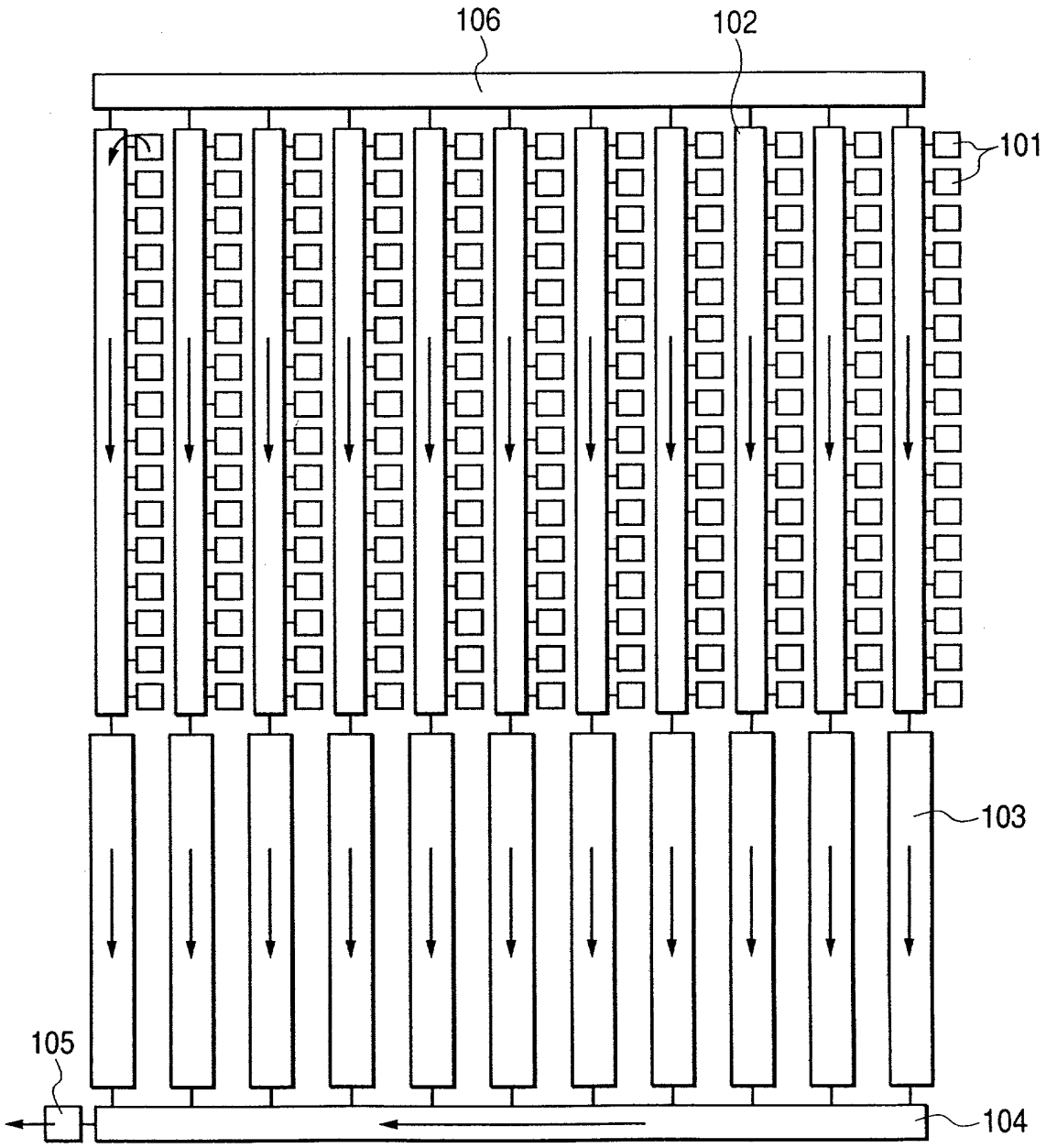
natural number) pixels; and

reading signals of pixels contained in a second image pickup area smaller than the first image pickup area, through addition of m (m < n, m is a natural number) pixels or without addition.

ABSTRACT OF THE DISCLOSURE

In order to form a magnified image without degradation of a resolution, signals of pixels contained in a first image pickup area are read through addition of n (n is a natural number) pixels, and signals of pixels contained in a second image pickup area smaller than the first image pickup area are read through addition of m (m < n, m is a natural number) pixels or without addition.

FIG. 1



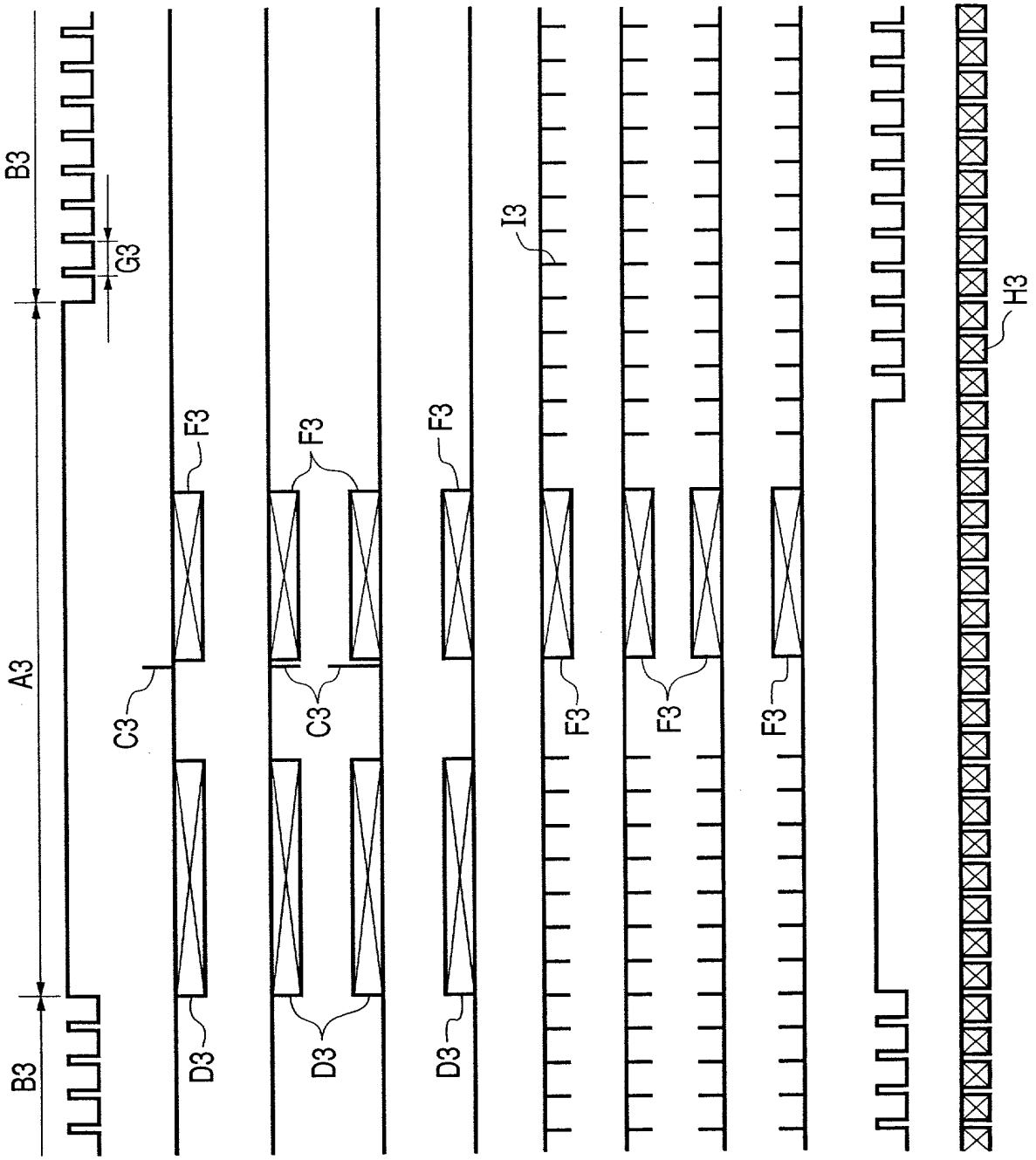


FIG. 2A

FIG. 2B

FIG. 2C

FIG. 2D

FIG. 2E

FIG. 2F

FIG. 2G

FIG. 2H

FIG. 2I

FIG. 2J

FIG. 2K

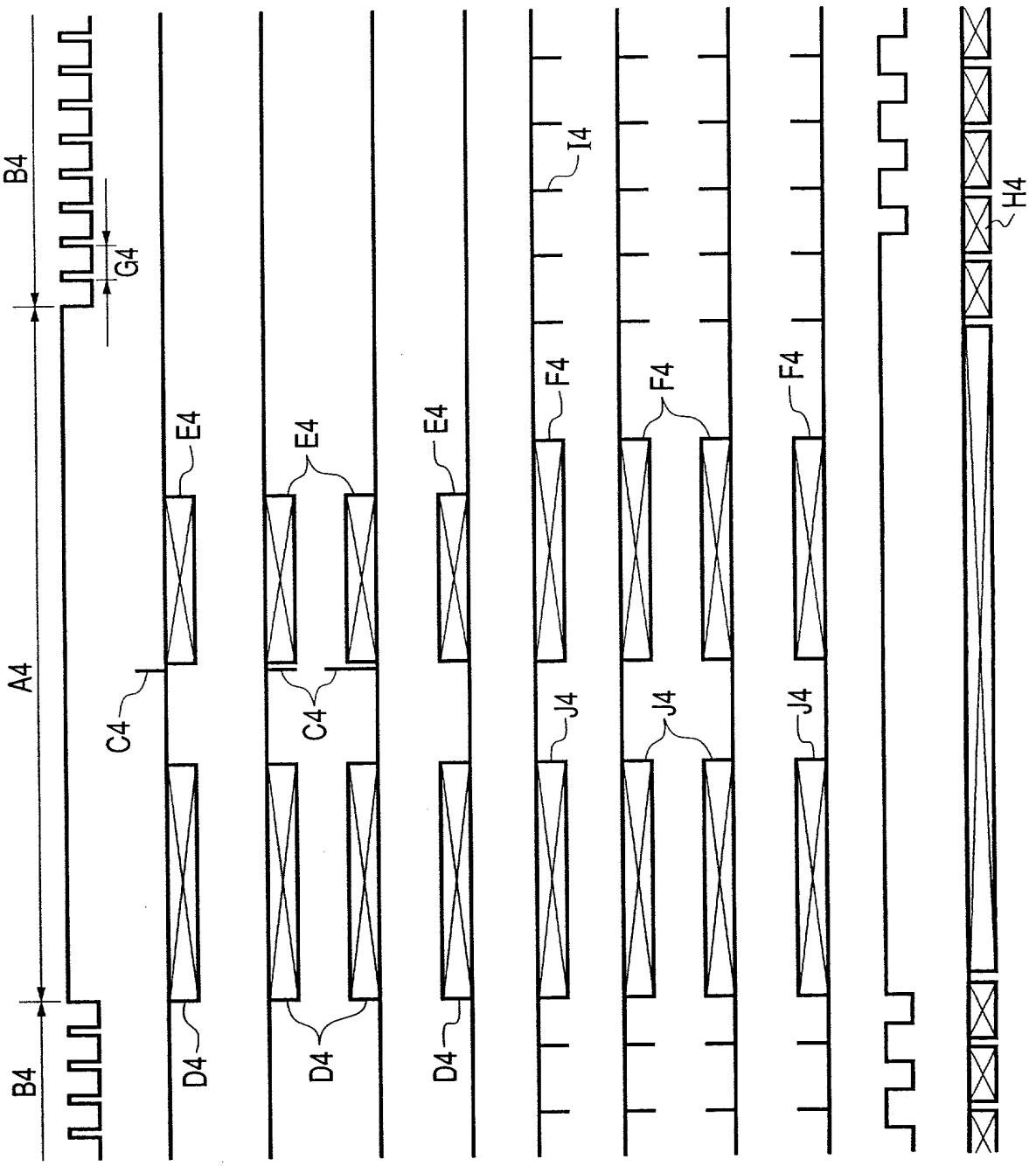


FIG. 3A
FIG. 3B
FIG. 3C
FIG. 3D
FIG. 3E
FIG. 3F
FIG. 3G
FIG. 3H
FIG. 3I
FIG. 3J
FIG. 3K

FIG. 4A

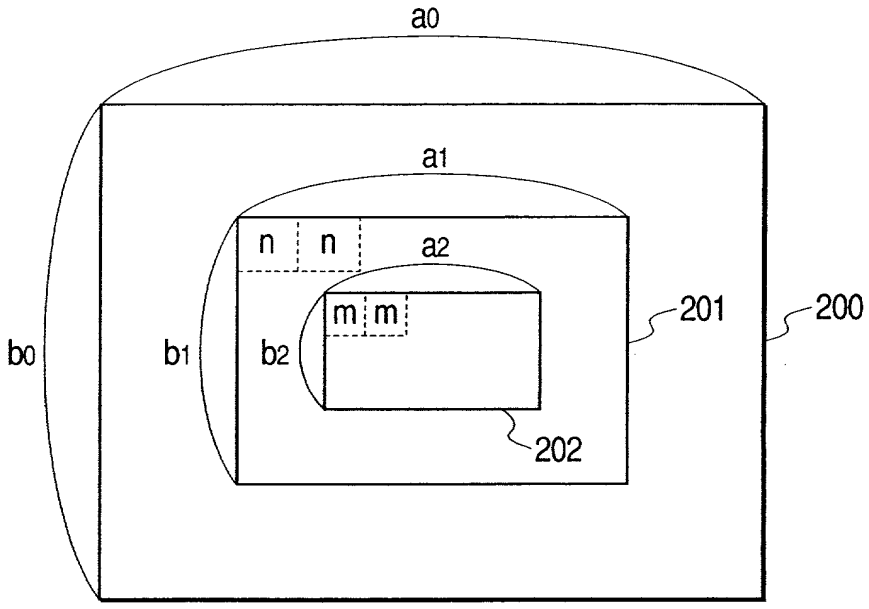


FIG. 4B

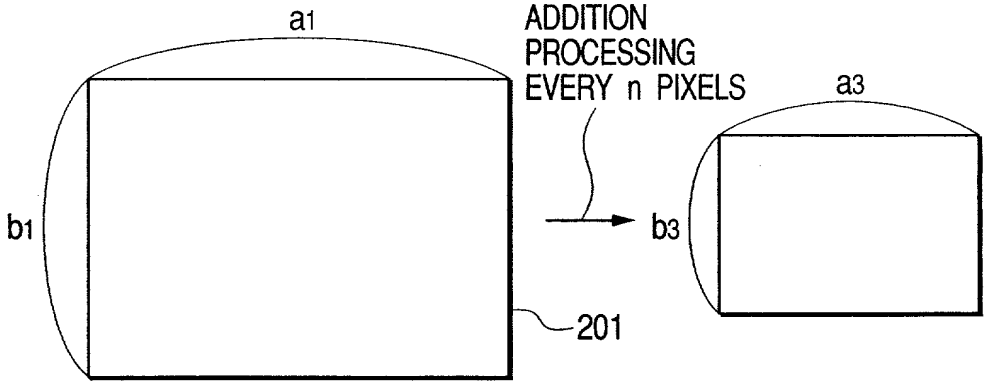


FIG. 4C

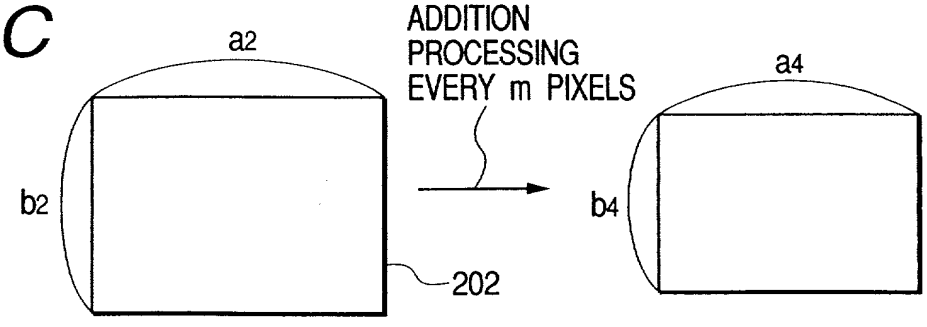


FIG. 5

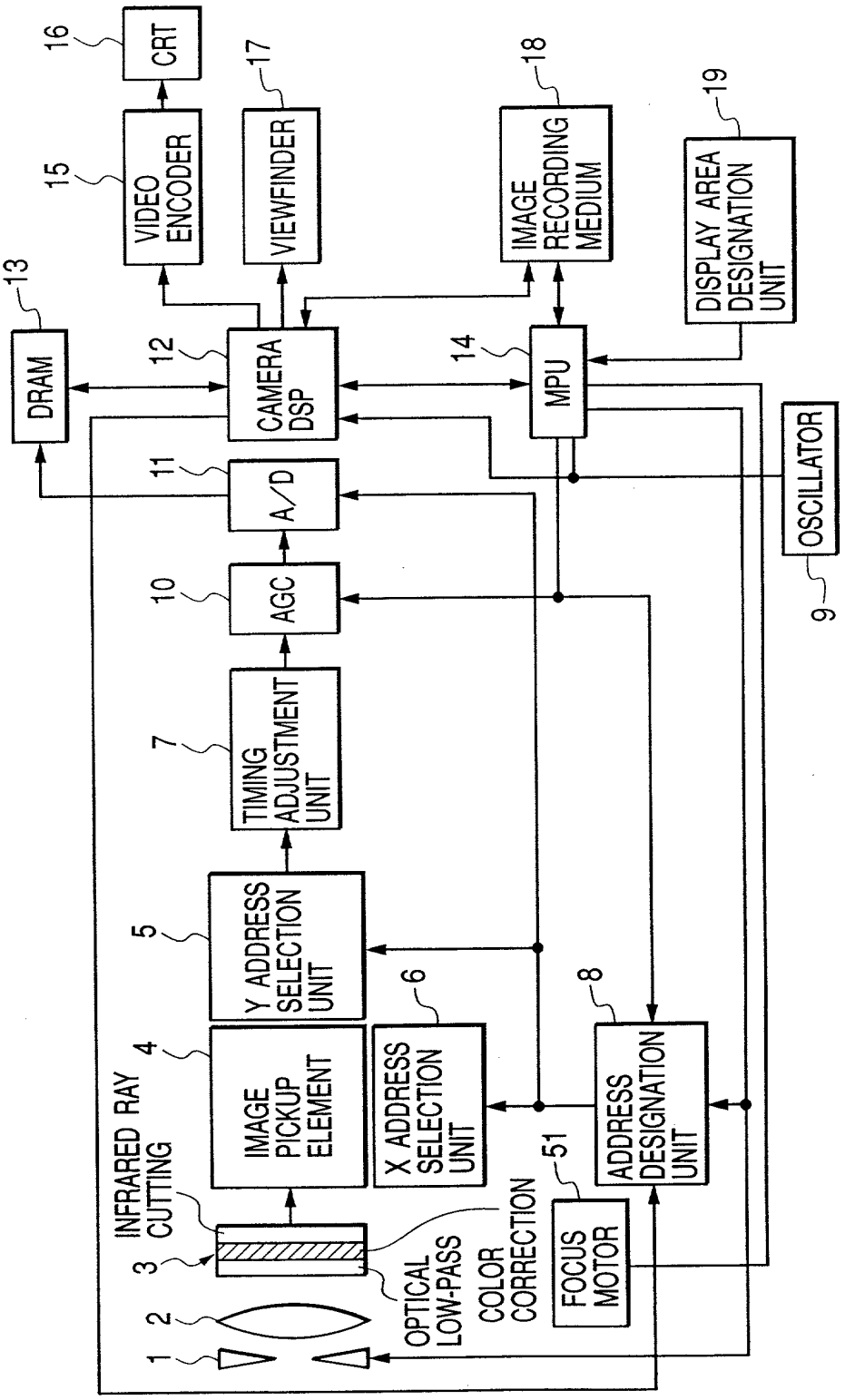

1
2
3
INFRARED RAY CUTTING
OPTICAL LOW-PASS
4
IMAGE PICKUP ELEMENT
5
Y ADDRESS SELECTION UNIT
6
X ADDRESS SELECTION UNIT
7
TIMING ADJUSTMENT UNIT
8
ADDRESS DESIGNATION UNIT
9
OSCILLATOR
10
AGC
11
A/D
12
CAMERA DSP
13
DRAM
14
MPU
15
VIDEO ENCODER
16
CRT
17
VIEWFINDER
18
IMAGE RECORDING MEDIUM
19
DISPLAY AREA DESIGNATION UNIT
51
FOCUS MOTOR
COLOR CORRECTION

FIG. 6

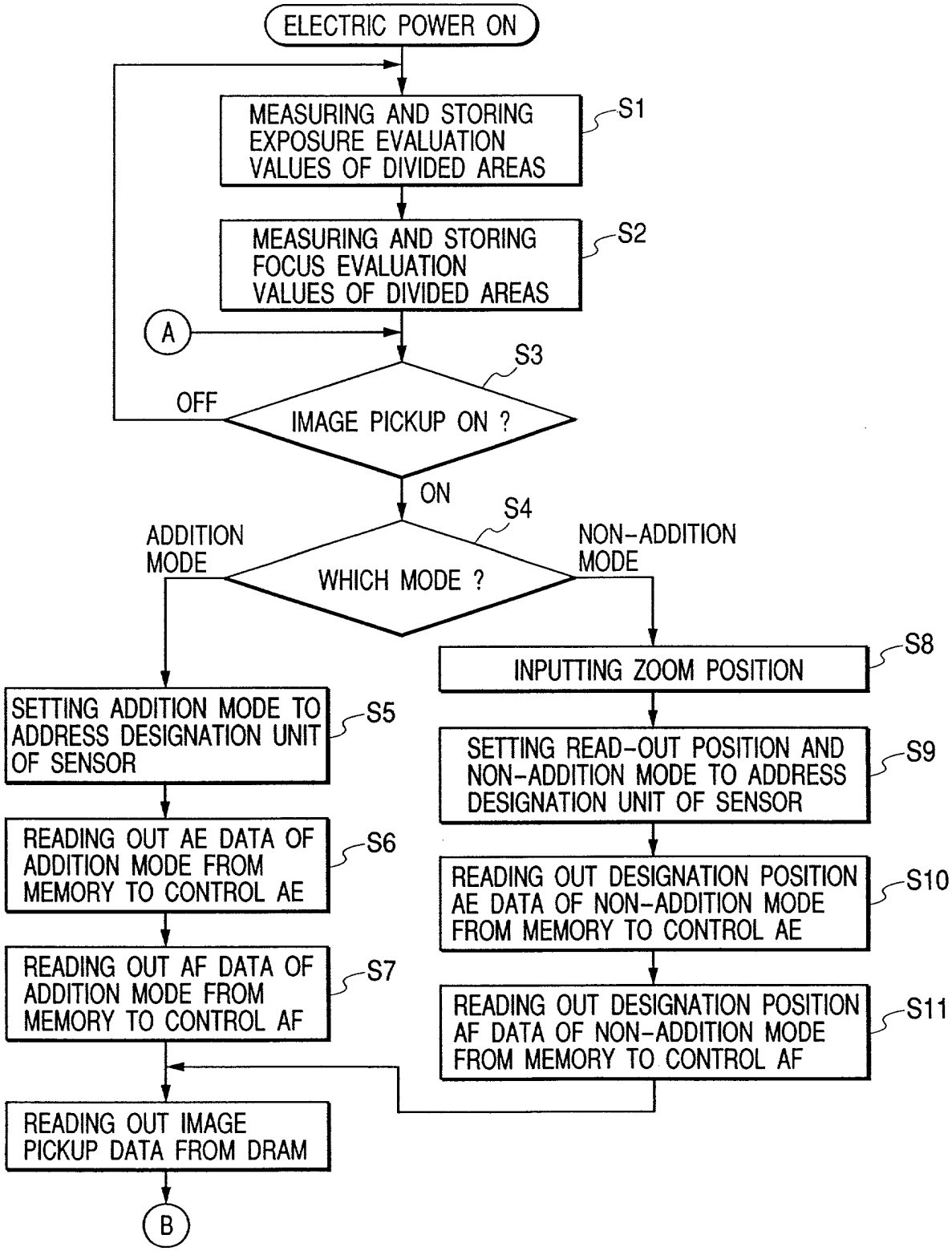

ELECTRIC POWER ON
MEASURING AND STORING EXPOSURE EVALUATION VALUES OF DIVIDED AREAS
S1
MEASURING AND STORING FOCUS EVALUATION VALUES OF DIVIDED AREAS
S2
A
S3
OFF
IMAGE PICKUP ON ?
ON
S4
ADDITION MODE
WHICH MODE ?
NON-ADDITION MODE
INPUTTING ZOOM POSITION
S8
SETTING ADDITION MODE TO ADDRESS DESIGNATION UNIT OF SENSOR
S5
SETTING READ-OUT POSITION AND NON-ADDITION MODE TO ADDRESS DESIGNATION UNIT OF SENSOR
S9
READING OUT AE DATA OF ADDITION MODE FROM MEMORY TO CONTROL AE
S6
READING OUT DESIGNATION POSITION AE DATA OF NON-ADDITION MODE FROM MEMORY TO CONTROL AE
S10
READING OUT AF DATA OF ADDITION MODE FROM MEMORY TO CONTROL AF
S7
READING OUT DESIGNATION POSITION AF DATA OF NON-ADDITION MODE FROM MEMORY TO CONTROL AF
S11
READING OUT IMAGE PICKUP DATA FROM DRAM
B

FIG. 7

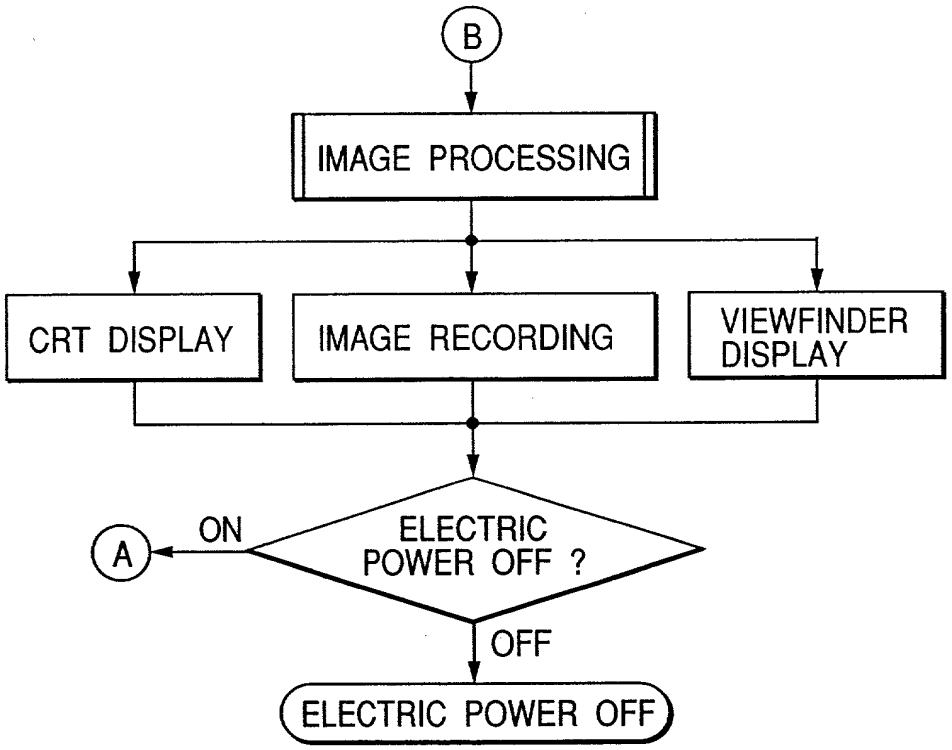

B
IMAGE PROCESSING
CRT DISPLAY
IMAGE RECORDING
VIEWFINDER DISPLAY
ON
A
ELECTRIC POWER OFF ?
OFF
ELECTRIC POWER OFF

FIG. 8

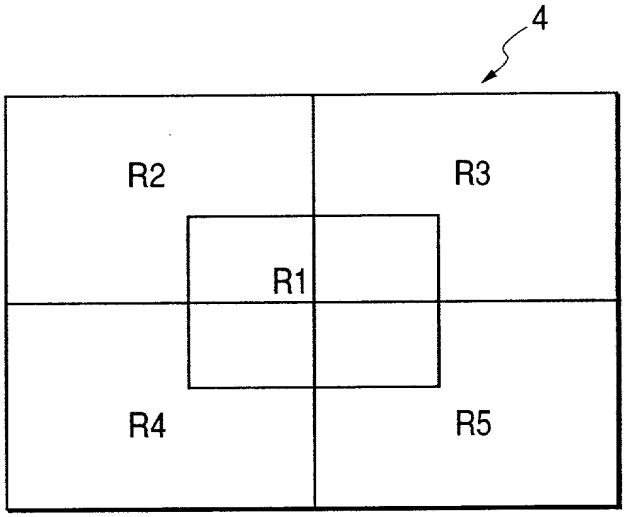

4
R2
R3
R1
R4
R5

FIG. 9

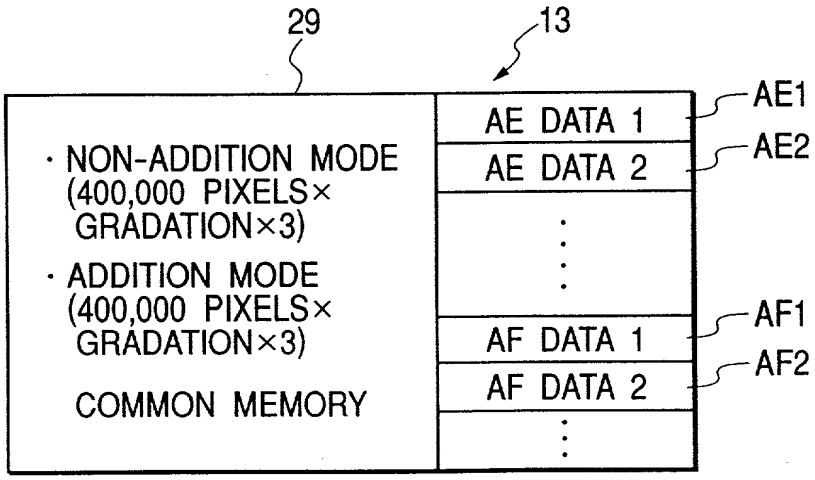

29
13
· NON-ADDITION MODE (400,000 PIXELS× GRADATION×3)
· ADDITION MODE (400,000 PIXELS× GRADATION×3)
COMMON MEMORY
AE DATA 1
AE DATA 2
AF DATA 1
AF DATA 2
AE1
AE2
AF1
AF2

FIG. 10

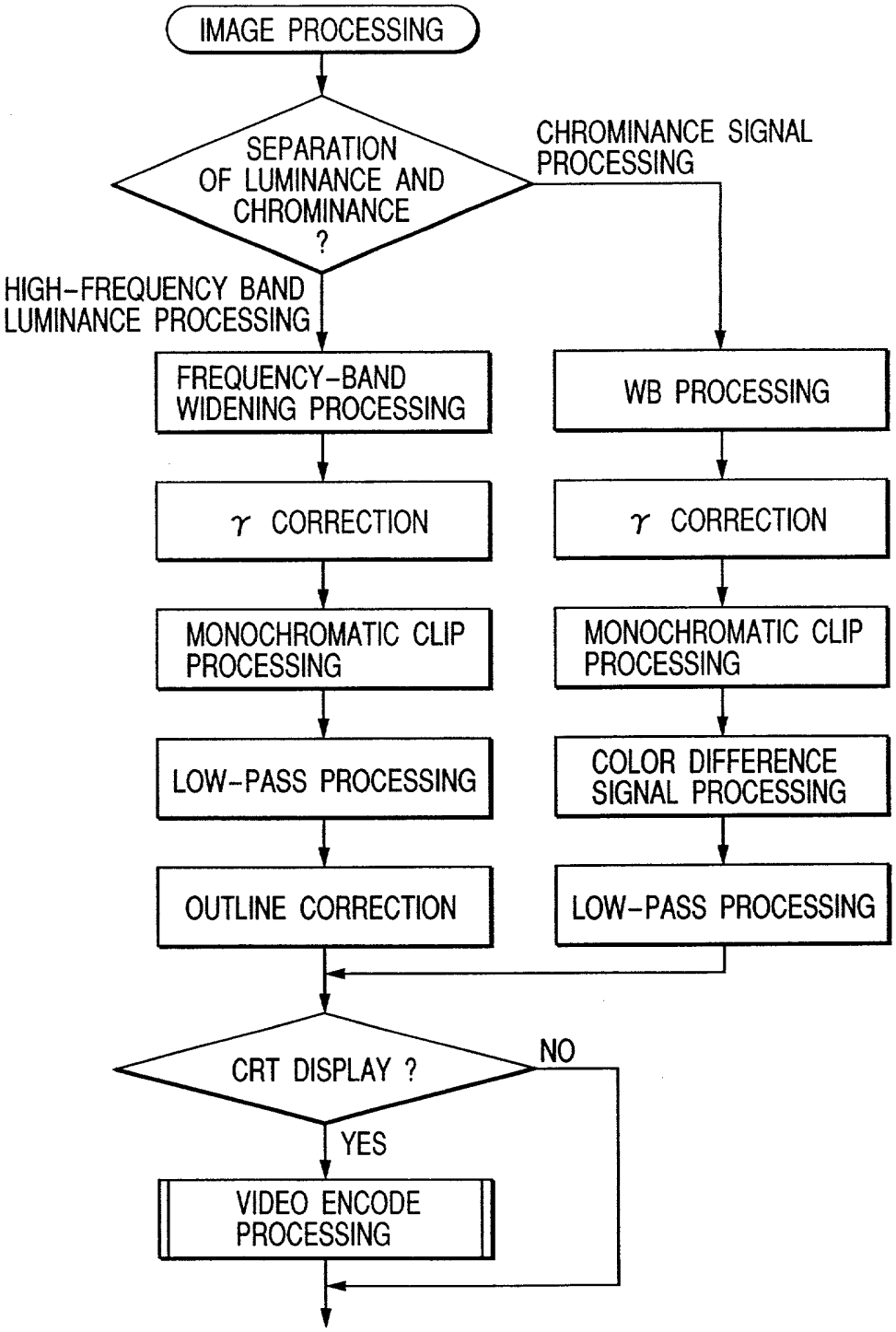


IMAGE PROCESSING
SEPARATION OF LUMINANCE AND CHROMINANCE ?
CHROMINANCE SIGNAL PROCESSING
HIGH-FREQUENCY BAND LUMINANCE PROCESSING
FREQUENCY-BAND WIDENING PROCESSING
γ CORRECTION
MONOCHROMATIC CLIP PROCESSING
LOW-PASS PROCESSING
OUTLINE CORRECTION
WB PROCESSING
γ CORRECTION
MONOCHROMATIC CLIP PROCESSING
COLOR DIFFERENCE SIGNAL PROCESSING
LOW-PASS PROCESSING
CRT DISPLAY ?
NO
YES
VIDEO ENCODE PROCESSING

FIG. 11

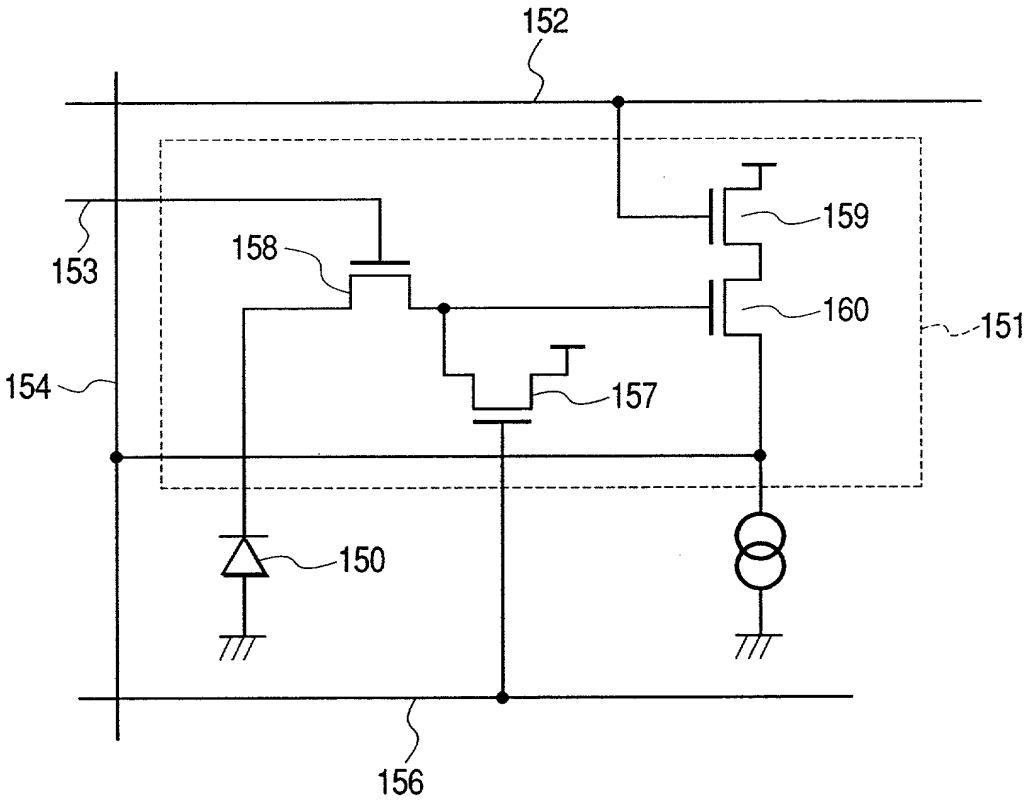


FIG. 12

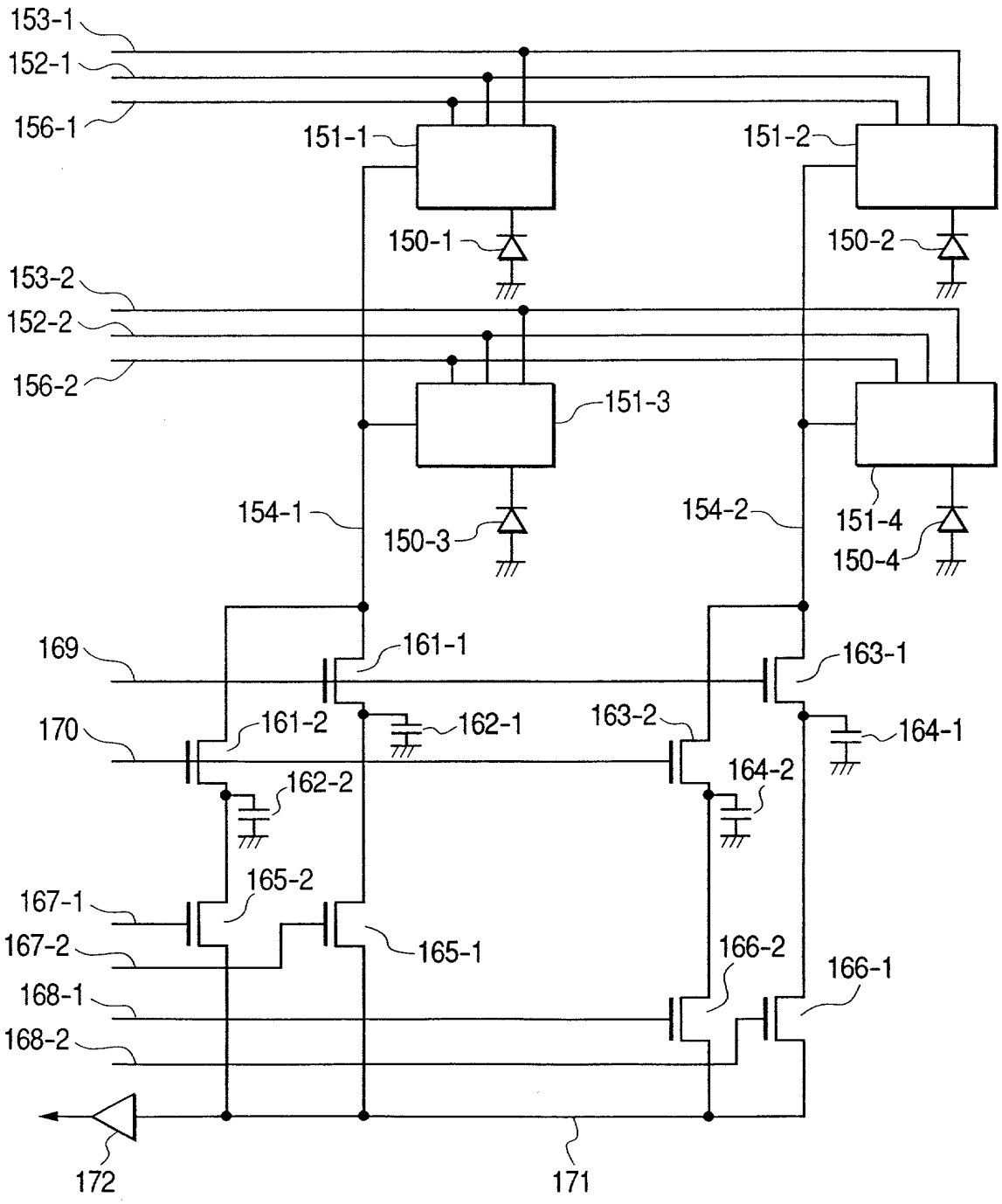

153-1
152-1
156-1
151-1
151-2
150-1
150-2
153-2
152-2
156-2
151-3
154-1
150-3
154-2
151-4
150-4
169
161-1
163-1
170
161-2
162-1
163-2
164-1
162-2
164-2
165-2
167-1
167-2
165-1
166-2
166-1
168-1
168-2
172
171

FIG. 13

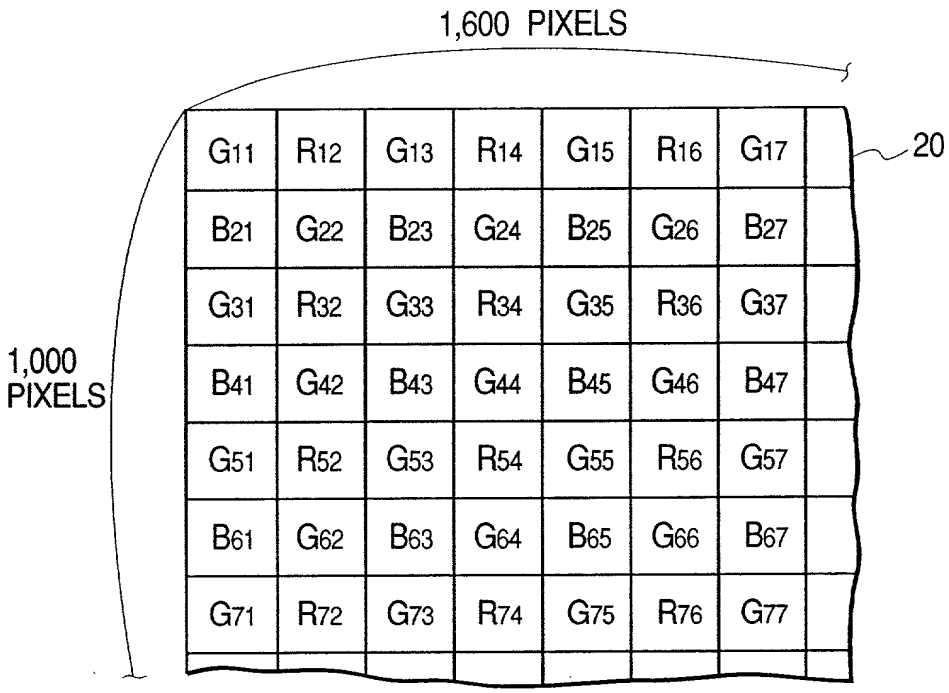

1,600 PIXELS
1,000 PIXELS
20
G11 R12 G13 R14 G15 R16 G17
B21 G22 B23 G24 B25 G26 B27
G31 R32 G33 R34 G35 R36 G37
B41 G42 B43 G44 B45 G46 B47
G51 R52 G53 R54 G55 R56 G57
B61 G62 B63 G64 B65 G66 B67
G71 R72 G73 R74 G75 R76 G77

FIG. 14

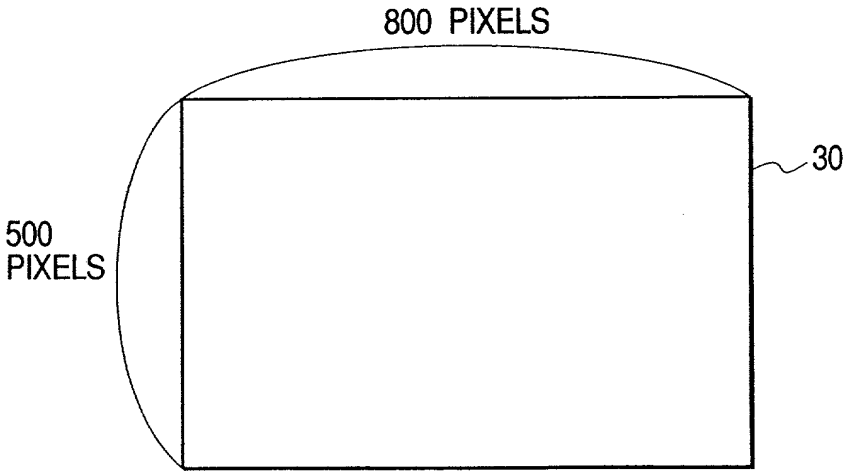

800 PIXELS
500 PIXELS
30

FIG. 15

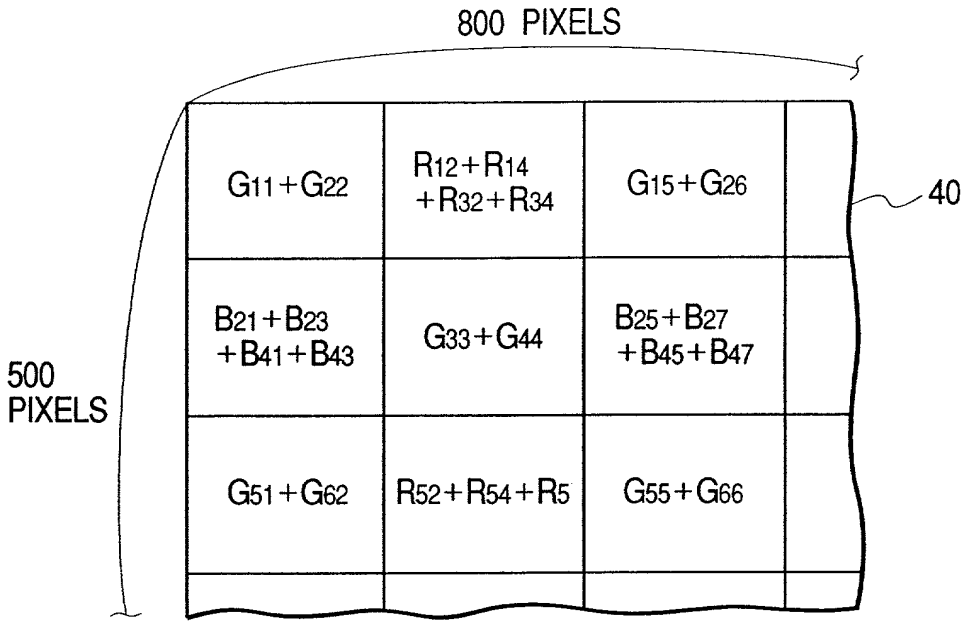

800 PIXELS
500 PIXELS
G11+G22
R12+R14 +R32+R34
G15+G26
B21+B23 +B41+B43
G33+G44
B25+B27 +B45+B47
G51+G62
R52+R54+R5
G55+G66
40

FIG. 16

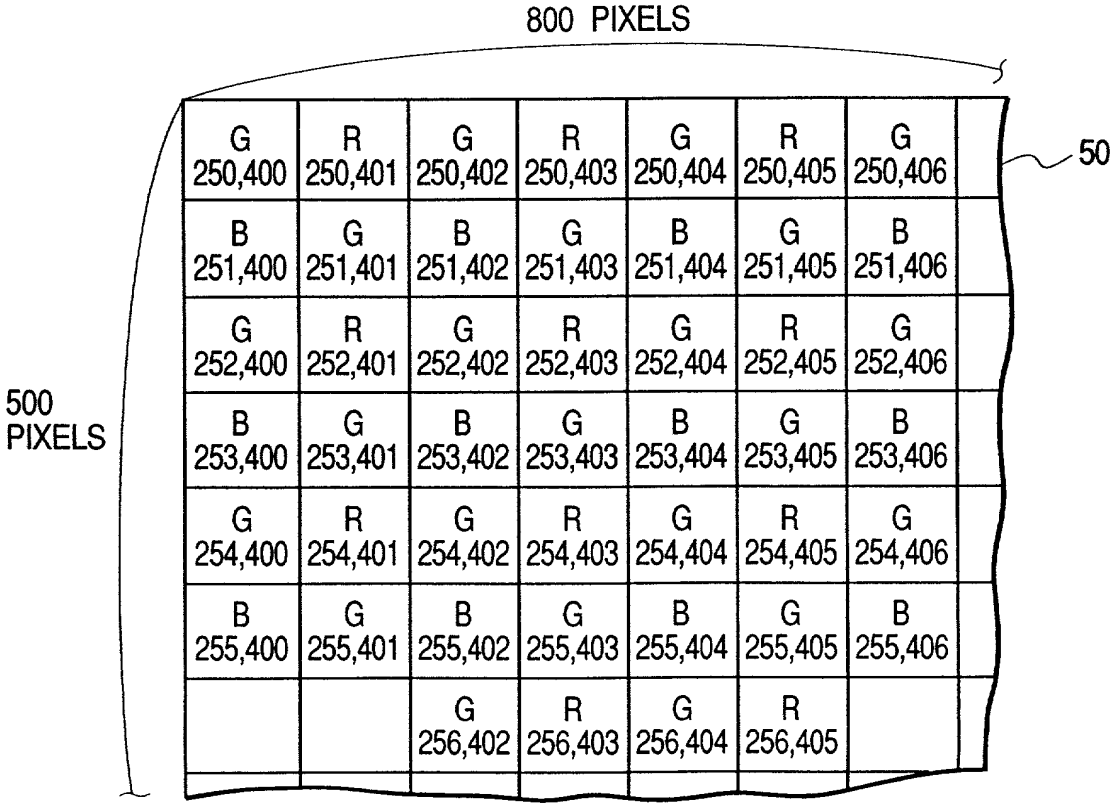

800 PIXELS
500 PIXELS
G 250,400
R 250,401
G 250,402
R 250,403
G 250,404
R 250,405
G 250,406
B 251,400
G 251,401
B 251,402
G 251,403
B 251,404
G 251,405
B 251,406
G 252,400
R 252,401
G 252,402
R 252,403
G 252,404
R 252,405
G 252,406
B 253,400
G 253,401
B 253,402
G 253,403
B 253,404
G 253,405
B 253,406
G 254,400
R 254,401
G 254,402
R 254,403
G 254,404
R 254,405
G 254,406
B 255,400
G 255,401
B 255,402
G 255,403
B 255,404
G 255,405
B 255,406
G 256,402
R 256,403
G 256,404
R 256,405
50

FIG. 17

G11+G13+G15+G17 +G22+G24+G26+G28 +G31+G33+G35+G37 +G42+G44+G46+G48	R12+R14+R16+R18 +R32+R34+R36+R38 +R52+R54+R56+R58 +R72+R74+R76+R78	G19+G111+G113+G115 +G210+G212+G214+G216 +G309+G311+G313+G315 +G410+G412+G414+G416	
B21+B23+B25+B27 +B41+B43+B45+B47 +B61+B63+B65+B67 +B81+B83+B85+B87	G55+G57+G59+G511 +G66+G68+G610+G612 +G75+G77+G79+G711 +G86+G88+G810+G812	B29+B31+B33+B35 +B49+B51+B53+B55 +B69+B71+B73+B75 +B89+B811+B813+B815	
G91+G93+G95+G97 +G102+G104+G106+G107 +G111+G113+G115+G117 +G122+G124+G126+G128	R92+R94+R96+R98 +R112+R114+R116+R118 +R132+R134+R136+R138 +R152+R154+R156+R158	G99+G911+G913+G915 +G1010+G1012+G1014+G1016 +G119+G1111+G1113+G1115 +G1210+G1212+G1214+G1216	
B101+B103+B105+B107 +B121+B123+B125+B127 +B141+B143+B145+B147 +B161+B163+B165+B167	G135+G137+G139+G1311 +G146+G148+G1410+G1412 +G155+G157+G159+G1511 +G166+G168+G1610+G1612	B109+B1011+B1013+B1015 +B129+B1211+B1213+B1215 +B149+B1411+B1413+B1415 +B169+B1611+B1613+B1615	

FIG. 18

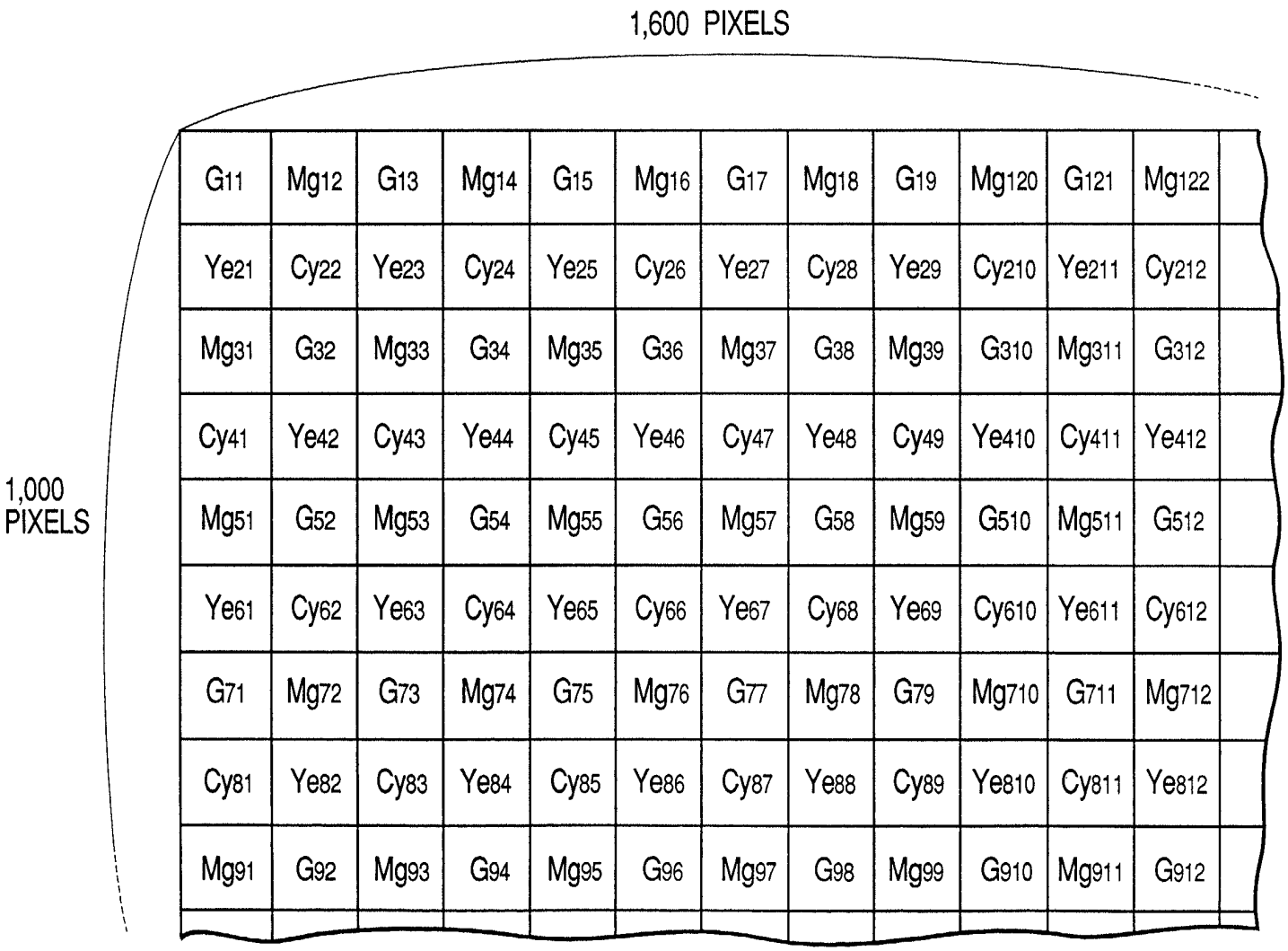

1,600 PIXELS
1,000 PIXELS
G11 Mg12 G13 Mg14 G15 Mg16 G17 Mg18 G19 Mg120 G121 Mg122
Ye21 Cy22 Ye23 Cy24 Ye25 Cy26 Ye27 Cy28 Ye29 Cy210 Ye211 Cy212
Mg31 G32 Mg33 G34 Mg35 G36 Mg37 G38 Mg39 G310 Mg311 G312
Cy41 Ye42 Cy43 Ye44 Cy45 Ye46 Cy47 Ye48 Cy49 Ye410 Cy411 Ye412
Mg51 G52 Mg53 G54 Mg55 G56 Mg57 G58 Mg59 G510 Mg511 G512
Ye61 Cy62 Ye63 Cy64 Ye65 Cy66 Ye67 Cy68 Ye69 Cy610 Ye611 Cy612
G71 Mg72 G73 Mg74 G75 Mg76 G77 Mg78 G79 Mg710 G711 Mg712
Cy81 Ye82 Cy83 Ye84 Cy85 Ye86 Cy87 Ye88 Cy89 Ye810 Cy811 Ye812
Mg91 G92 Mg93 G94 Mg95 G96 Mg97 G98 Mg99 G910 Mg911 G912

FIG. 19

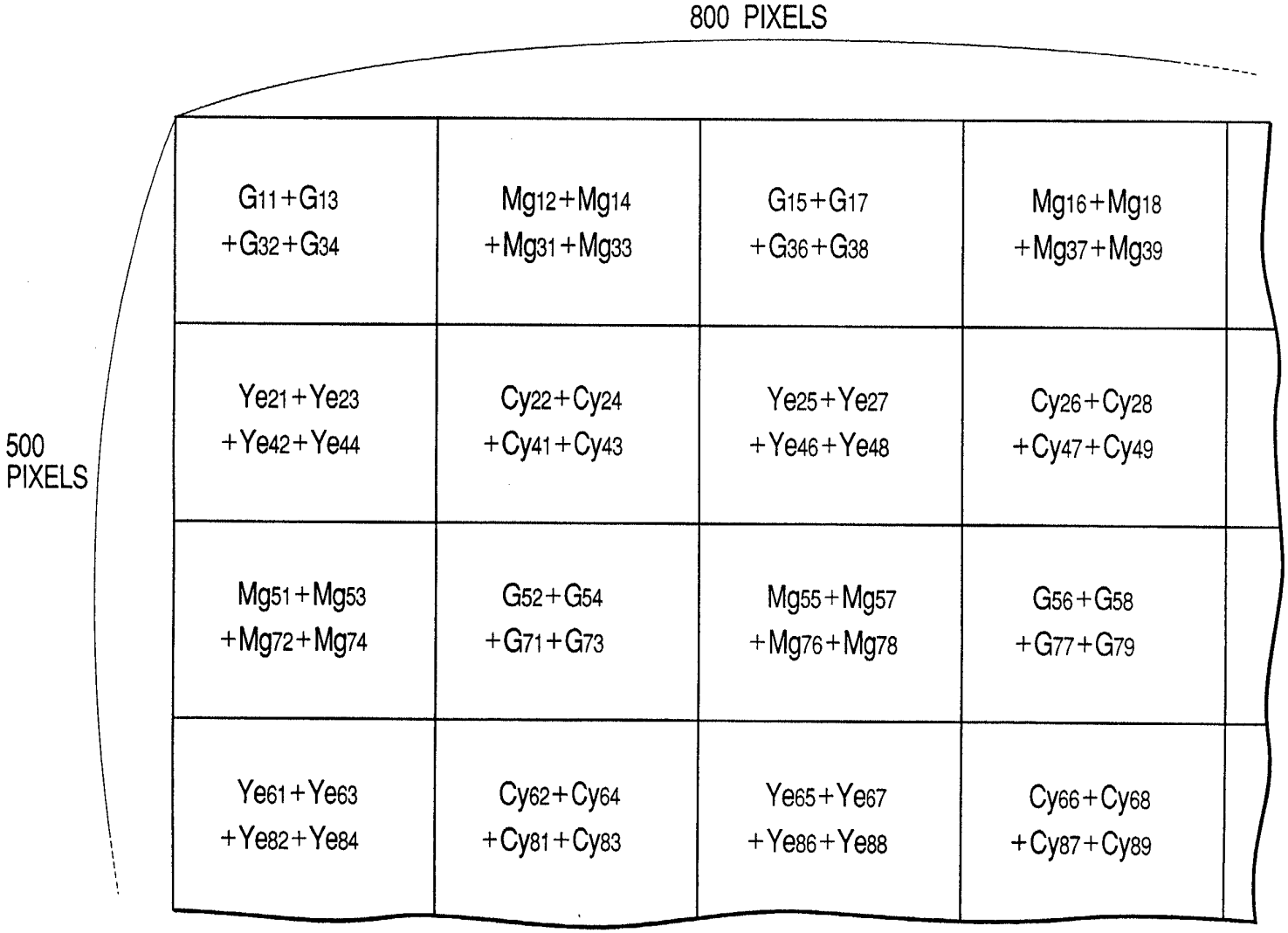

800 PIXELS
500 PIXELS
G11+G13 +G32+G34
Mg12+Mg14 +Mg31+Mg33
G15+G17 +G36+G38
Mg16+Mg18 +Mg37+Mg39
Ye21+Ye23 +Ye42+Ye44
Cy22+Cy24 +Cy41+Cy43
Ye25+Ye27 +Ye46+Ye48
Cy26+Cy28 +Cy47+Cy49
Mg51+Mg53 +Mg72+Mg74
G52+G54 +G71+G73
Mg55+Mg57 +Mg76+Mg78
G56+G58 +G77+G79
Ye61+Ye63 +Ye82+Ye84
Cy62+Cy64 +Cy81+Cy83
Ye65+Ye67 +Ye86+Ye88
Cy66+Cy68 +Cy87+Cy89

FIG. 20

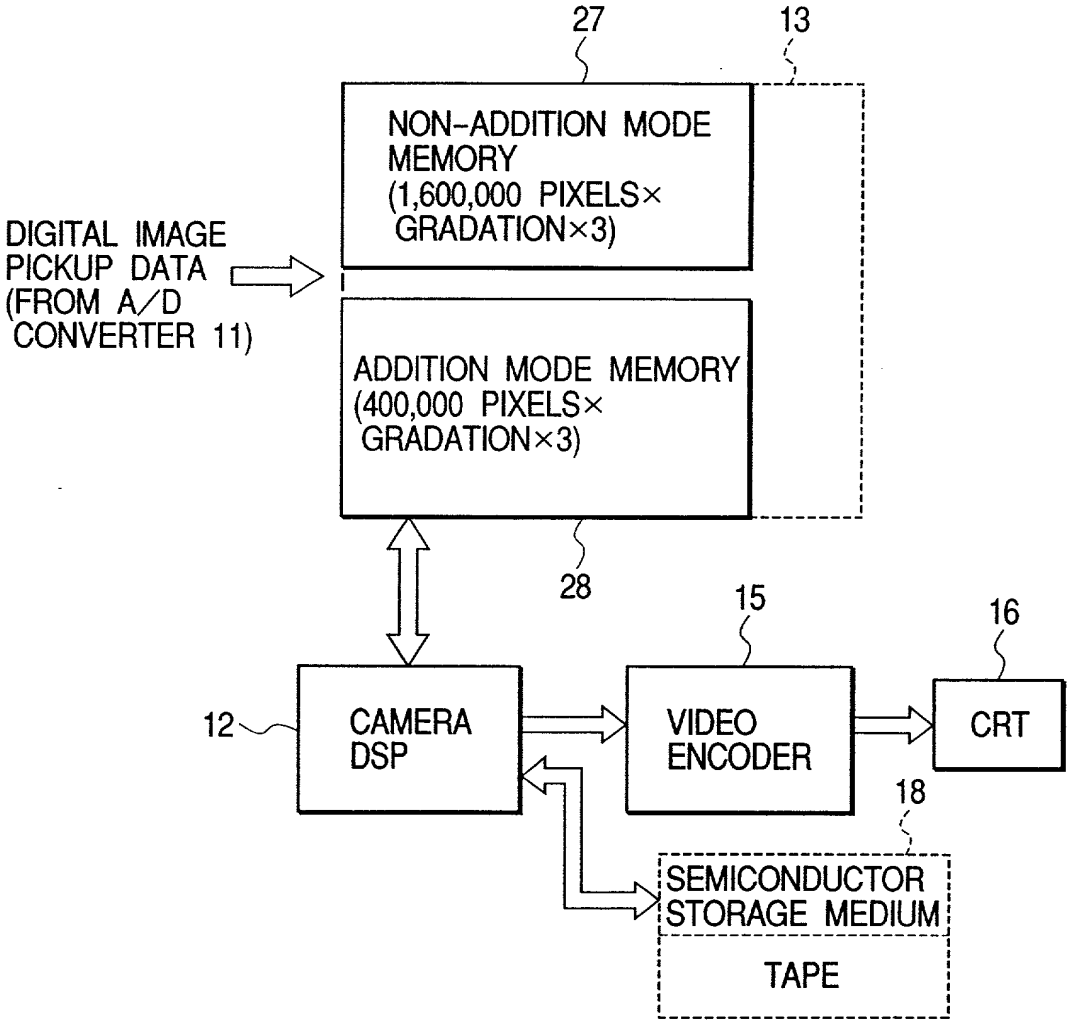

27
13
NON-ADDITION MODE MEMORY (1,600,000 PIXELS× GRADATION×3)
DIGITAL IMAGE PICKUP DATA (FROM A/D CONVERTER 11)
ADDITION MODE MEMORY (400,000 PIXELS× GRADATION×3)
28
15
16
12
CAMERA DSP
VIDEO ENCODER
CRT
18
SEMICONDUCTOR STORAGE MEDIUM
TAPE

FIG. 21

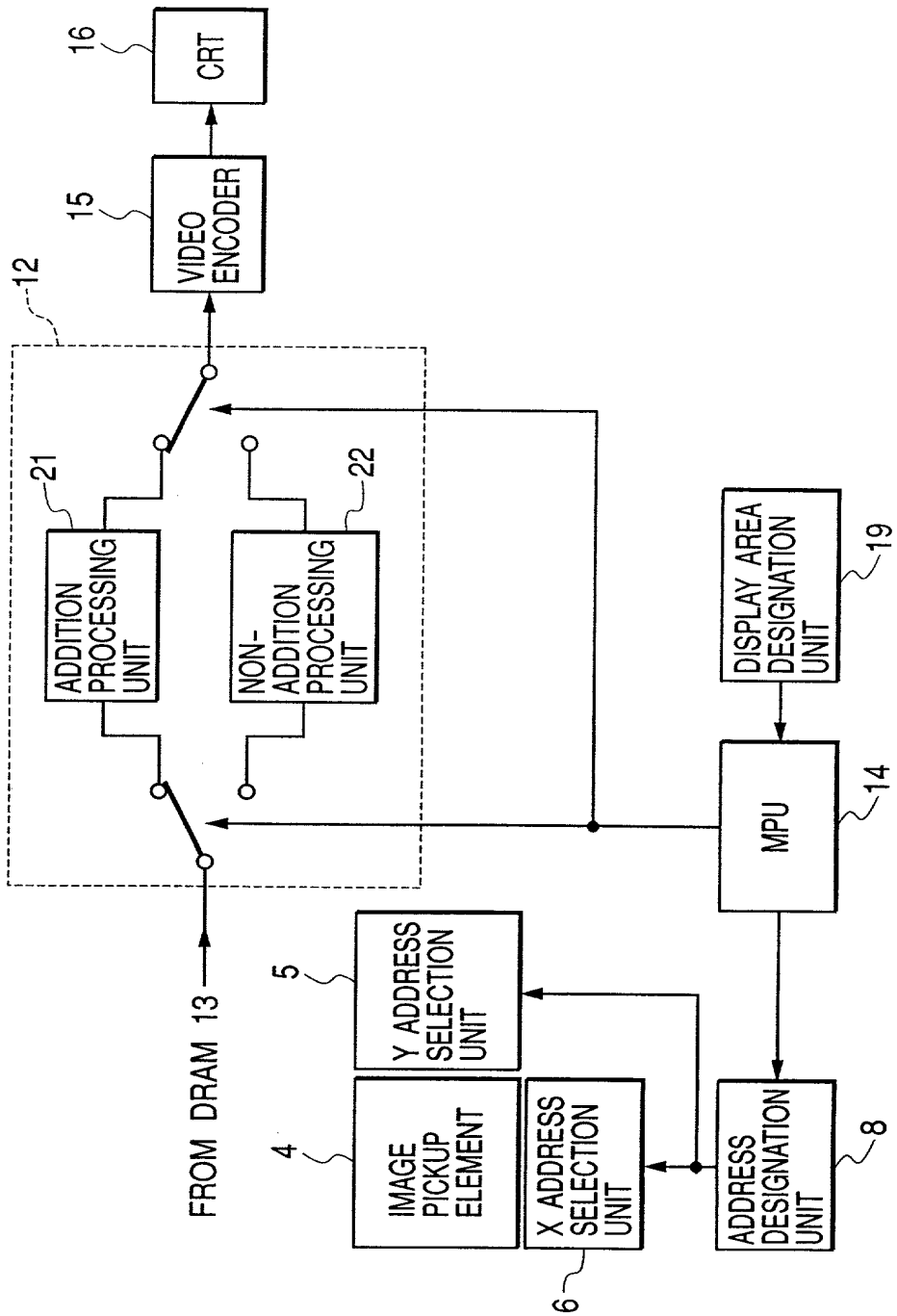
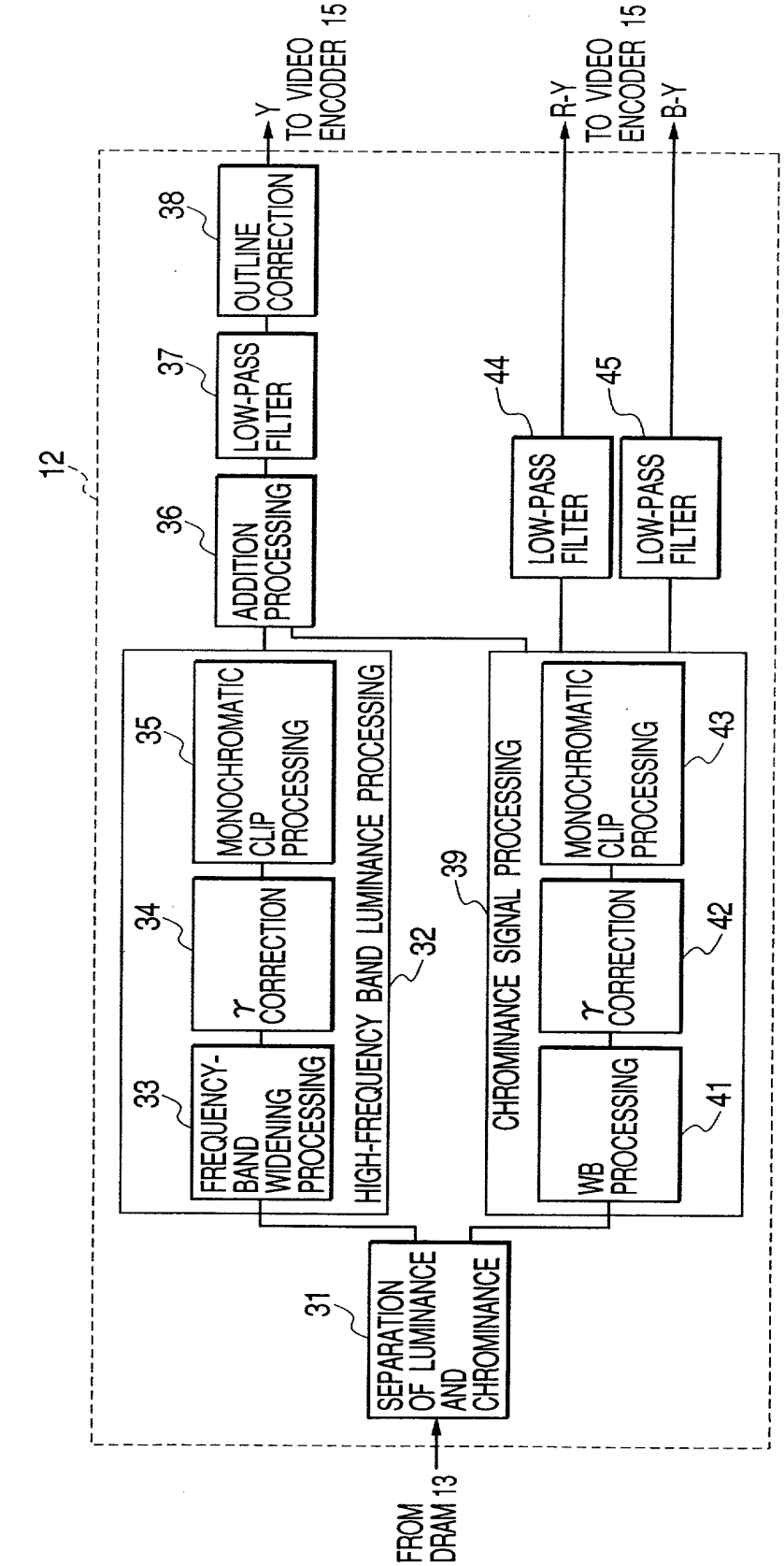

16
CRT
15
VIDEO ENCODER
12
21
ADDITION PROCESSING UNIT
22
NON-ADDITION PROCESSING UNIT
FROM DRAM 13
5
Y ADDRESS SELECTION UNIT
4
IMAGE PICKUP ELEMENT
X ADDRESS SELECTION UNIT
6
ADDRESS DESIGNATION UNIT
8
MPU
14
DISPLAY AREA DESIGNATION UNIT
19

FIG. 22


FROM DRAM 13
12
31
SEPARATION OF LUMINANCE AND CHROMINANCE
HIGH-FREQUENCY BAND LUMINANCE PROCESSING
32
33
FREQUENCY-BAND WIDENING PROCESSING
34
γ CORRECTION
35
MONOCHROMATIC CLIP PROCESSING
36
ADDITION PROCESSING
37
LOW-PASS FILTER
38
OUTLINE CORRECTION
Y
TO VIDEO ENCODER 15
39
CHROMINANCE SIGNAL PROCESSING
41
WB PROCESSING
42
γ CORRECTION
43
MONOCHROMATIC CLIP PROCESSING
44
LOW-PASS FILTER
45
LOW-PASS FILTER
R-Y
B-Y
TO VIDEO ENCODER 15

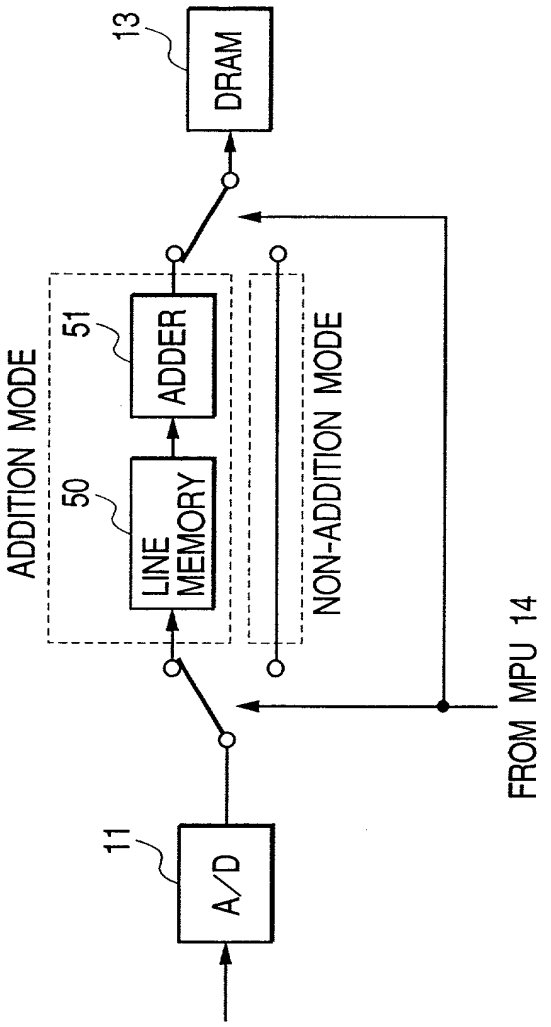

ADDITION MODE
NON-ADDITION MODE
11
A/D
50
LINE MEMORY
51
ADDER
13
DRAM
FROM MPU 14

FIG. 23

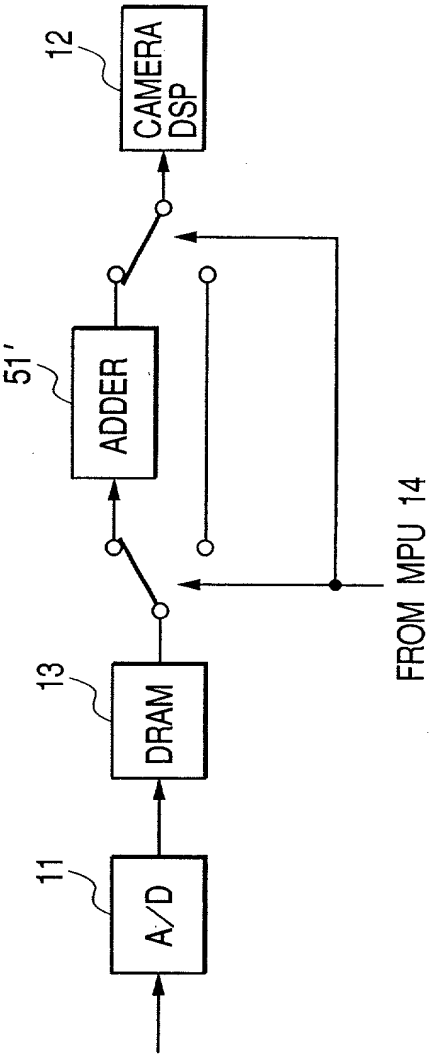

11
A/D
13
DRAM
51'
ADDER
12
CAMERA DSP
FROM MPU 14

FIG. 24

FIG. 25

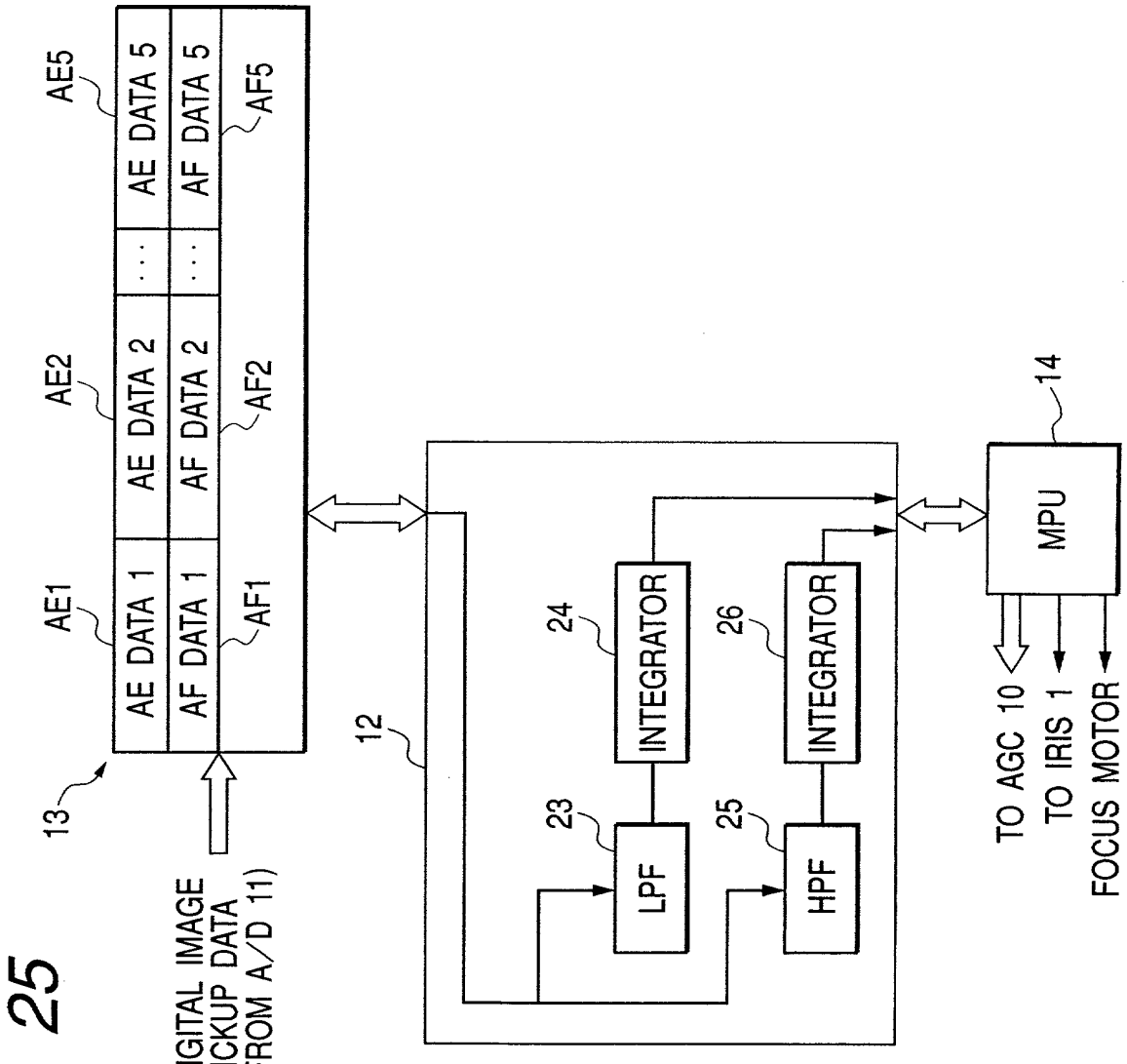

AE1
AE2
AE5
AE DATA 1
AE DATA 2
AE DATA 5
AF DATA 1
AF DATA 2
AF DATA 5
AF1
AF2
AF5
13
12
DIGITAL IMAGE PICKUP DATA (FROM A/D 11)
23
LPF
24
INTEGRATOR
25
HPF
26
INTEGRATOR
14
MPU
TO AGC 10
TO IRIS 1
FOCUS MOTOR

FIG. 26A

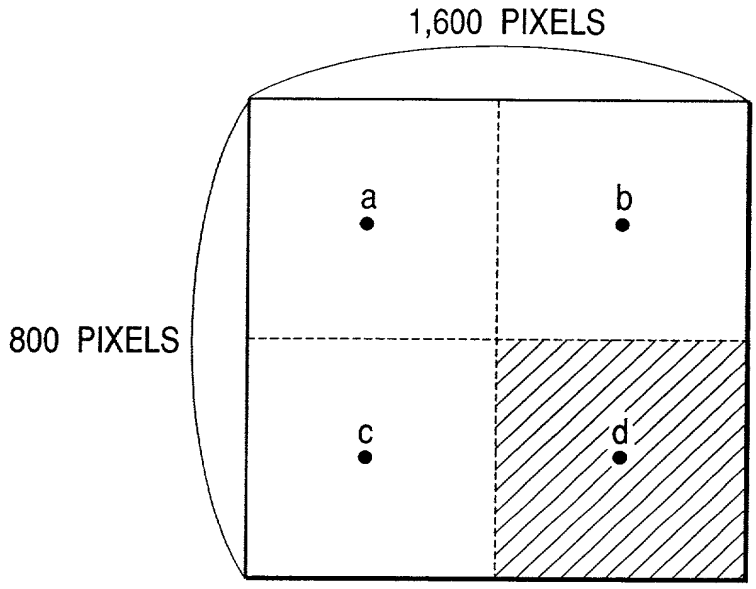
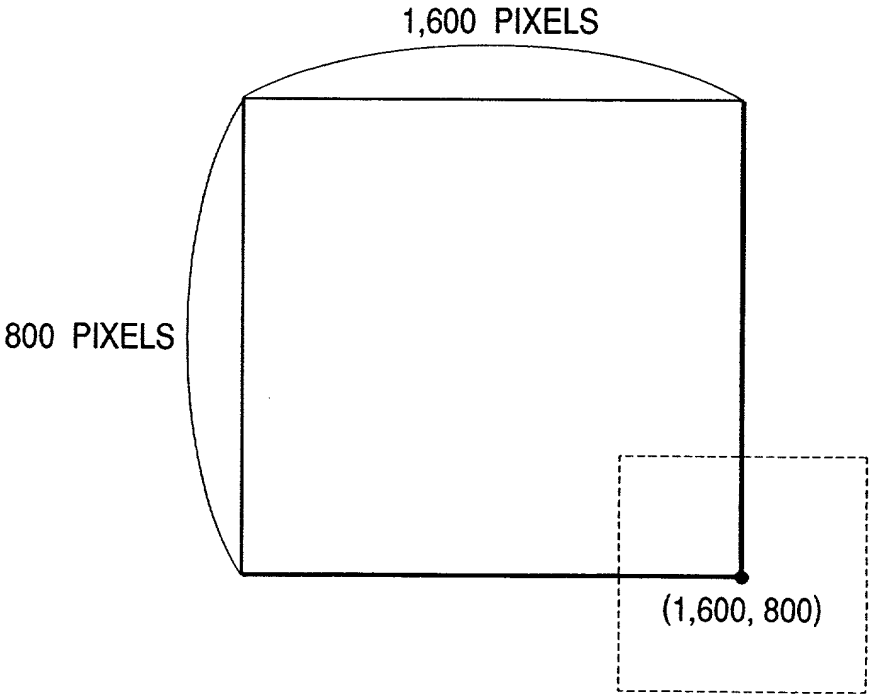


FIG. 26B



CFO 14771 US

COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

(Page 1)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled IMAGE PICKUP APPARATUS,

the specification of which [X] is attached hereto [ ] was filed on _____ as United States Application No. or PCT International Application No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b), of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designates at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed:

Country	Application No.	Filed (Day/Mo./Yr.)	(Yes/No) Priority Claimed
JAPAN	11-254745	8 September 1999	Yes

I hereby appoint the practitioners associated with the firm and Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

FITZPATRICK, CELLA, HARPER & SCINTO
Customer Number: 05514

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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